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Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous, Manufacturing and Technical, Current Price List.

The city of Galveston, Tex., recently granted a franchise for a sewerage system to a private company, as did New Orleans several months ago. The chief provisions of the Galveston franchise, according to the Galveston "News," are as follows:

The franchise is for 50 years, but the city may buy the system at any time. The system will be built in accordance with plans to be prepared by a "sanitary engineer," to be appointed by the Mayor, and will be built under the supervision of his engineer and the city engineer. The company makes no charge for removing the wastes from some of the public buildings. The city exempts the company from all taxes, and furnishes water for flushing sewers, free of charge. The city will compel all buildings to be connected with the sewers, and retains power to regulate the rates charged by the company for such connections. The construction of the system must be started by Dec. 19, 1892.

The New York & New Jersey Bridge Co. has issued lithographed drawings and descriptions of its proposed "Union Depot," which, "after a careful survey by our engineers, the Commissioners re-located from 38th to 42d Sts., 7th Ave. and Broadway," while the same body located "the approaches from the bridge at 70th St., southerly, between 11th and 12th Aves. to 45th St." Who the commissioners are, where the depot and approach were before they were "re-located," why there was a necessity for a "careful survey by our engineers" before such a location and in the present state of the enterprise, other than such a survey as can be made from the box seat of an open carriage, are not explained; which seems the more singular because the specifications and plans of the proposed terminal structure and methods of handling trains in and out of it are very detailed. As the actual construction of this terminal station would only be begun after the bridge itself was nearly completed, and as the plans would be quite certain to undergo very extensive alterations and revisions in the meantime, it is difficult to see any useful purpose in even studying plans for a terminal station, much less making them public, at this stage in the game, when the company is not yet prepared to announce even the design for the bridge itself, much less the beginning of work on it. But one reasonable purpose can be imagined—to bring and keep the enterprise before the public eye. A more legitimate way to do this, however, would be to prepare and announce plans for the bridge, and when work upon it was to begin, in both of which engineers would take a deep interest. Our view of the matter is, that they will take little or no interest in detail sketches of trainsheds which may or may not be built six or eight years hence. Therefore we have not felt justified in giving the necessary space to a reproduction of them at the present time.

Cold rolled copper wire is to be made by the United States Cold Wire Rolling Co., of Chicago, incorporated with $500,000 capital. The factory is to be built at Hammond, Ind. The President of the company, Judge Van H. Higgins, says that tests made by government engineers show a tensile strength of 105,000 lbs. per sq. in. for this wire, as compared with 56,000 lbs. for ordinary drawn copper wire. The cost of drawing is from $5.50 to $6 per ton; the company named expects to roll wire at a cost of about $1 per ton. They will also make all kinds of iron wire and wire nails.

A fly wheel accident of a somewhat peculiar nature occurred on Sept. 22, at the Sioux City electric light stations. Two engines were operating a fly wheel 11 ft. in diameter, weighing 3 tons, and running at 210 revolutions per minute. The belt leading from it to the dynamos slipped off and fell upon the shafting. The wheel relieved of the strain upon it, "ran away," and finally threw the belt into the machinery, and tore off the governors. The engine then went beyond the control of the workmen, and a moment after the great wheel burst. One of the pieces cut a feed pipe and another tore through the wires overhead, and formed a short circuit on the dynamos supplying the arc circuits. This sent the shaft wheels in another part of the house off at an alarming rate, and another belt was thrown off, but beyond the machinery. One of the engineers finally succeeded in reaching the cut-off valve, and shut off the steam.

The Lansing electric railway running to the Fair Grounds has recently done some very heavy work. The cars have Westinghouse double reduction motors. Two 16-ft. closed cars were used, supplied each with two 15-HP. motors. One motor car pulled two 20-ft. "trailers" twelve hours per day for three days, up a 4½% grade and around two curves of 45 ft. radius. They were loaded from 8 a. m. to 7 p. m., full capacity, averaging 300 passengers to the load and on one trip fares were collected from 300 people. This feat is claimed to be something greater than was ever before attempted by this size of motor, but there was no faltering. The huge train loads moved along easily and apparently with no strain on the machinery.

The most serious railway accident of the week was a rear collision on the Chicago & Great Western Ry., at New Hampton, Ia., Sept. 24. A fast freight train ran into the caboose of a construction train, killing 7 persons and injuring 3 others. It is stated that the engineman of the freight train had no orders to stop at New Hampton.—By a derailment on the Chicago, Burlington & Quincy R. R., near Sibley, Ia., Sept. 21, an engine and 16 freight cars were thrown down a 10-ft. bank, and three or four emigrants were killed. The accident is attributed to spreading of the track.

The accident on the Pittsburg, Fort Wayne & Chicago R. R. at Shreve, O., Sept. 21, which was noted in our issue of Sept. 22, is said to have been caused by a blunder, but who was responsible for it has not yet developed. According to press dispatches, Superintendent Starr said: "There was no confusion of orders, as there were no orders. No one knows why the freight pulled out, but the supposition is that a fast freight, running between the limited east and No. 8, went by, and the freight crew mistook it for No. 8." It is said that the crew were asleep, and woke up in time to make this mistake. There were 12 persons killed (including 4 mail clerks, who were burned in their car), and about 12 injured.—In the derailment near Osage City, Kan., on the Atchison, Topeka & Santa Fe R. R., Sept. 21, which was also noted in our issue of Sept. 22, the shock extinguished the flames of the oil lamps. A press dispatch says: "The oil lamps in the coaches were overturned, and kerosene saturated the plush seats and trickled over the woodwork. All were in mortal fear that the flames would break out, and add to the horrors of the wreck those of fire, but the shock extinguished the lights before the flames could be communicated beyond the confines of the globes."

Two country highway bridge failures, caused by heavy loads passing over them, have been reported lately. One was a steel bridge near Quincy, Minn., which gave way under a traction engine on Sept. 18, two men being injured. The other was a bridge over a creek near Tryus, Minn., which gave way under a threshing machine Sept. 19. One man was fatally injured.

The "Campania" steamship, launched on Sept. 8, by the Fairfield Shipbuilding Co., of Glasgow, for the Cunard Co., has the following dimensions: Length over all, 620 ft.; breadth, 65¼ ft.; depth to upper deck, 43 ft.; gross tonnage, 12,500 tons. Two sets of triple expansion engines, the most powerful yet constructed, will drive the screws. Each set of engines is fitted with five inverted cylinders; two high-pressure, one intermediate and two low-pressure. Twelve double-ended boilers generate steam for the engines.

An electric train signal, to replace the old bell-rope, has been successfully tested at Portland, Me. An electric wire, covered with cord, runs from the engine to the rear of the train. The battery is in the engine. There are electric buttons in the baggage car, also on the outside of the car, and ornamental electric buttons in the passenger cars at frequent intervals. The couplings which connect the wire between the cars are waterproof, and so arranged that they will pull apart by any sudden strain without damage to themselves or the wire. If the train breaks in two the engineer is notified instantaneously by the ringing of a bell, and can at once notify the men in the baggage car of the fact.

The new East River bridge project of Mr. Uhlman is progressing slowly. According to the original program ground was to be broken in October, but the plans have not yet been submitted to the War Department, owing to the absence in Europe of the counsel of the bridge company. After the plans are pronounced satisfactory to the Government they must be approved by the municipal authorities of Brooklyn.

A bicycle record of one mile in 1 m. 56⅘ s. was made on the Independence, Ia., kite track, by the boy Johnson, on Sept. 22. He started 10 ft. back of the wire and was accompanied by two running horses, each horse making one-half mile. The first quarter was made in 29¼ s.; the half-mile in 58⅘ s., and the three-quarters in 1 m. 28½ s. This beats the late record of Zimmerman by about 8 seconds. Johnson, on Sept. 20, rode over the same track, from a standing start, in 2 m. 4¾ s.

A new steel lake passenger steamer is to be built by the Chicago Shipbuilding Co. for the Lake Michigan & Lake Superior Transit Co. This steamer will be 295 ft. over all, with 275 ft. on the keel; beam, 42 ft.; depth to spar deck, 24½ ft.. She will have triple expansion engines of 23, 38 and 62 ins. diameter and 30-in. stroke of piston. The estimated cost is $300,000.

A wooden highway bridge, built in 1829, was recently taken down at Delgeville, N. Y., and is to be replaced by a new bridge. The original bridge cost $550, and was warranted for 15 years. It was repaired in 1863, at a cost of $450, and since then has had little money expended upon it. It spanned the East Canada Creek, in the above-named village.

The Brooklyn Bridge Trustees have adopted a compromise plan for the Brooklyn station. This will be between Sands and High Sts., adjacent to, and parallel with Washington St. It will be a three-storied structure, with waiting rooms on first floor, bridge railway and platforms on second, and connections with elevated railways on the third floor.

The Hennepin Canal work is declared officially commenced, by the laying of the first stone on the guard-lock, on Sept. 9. Capt. Wheeler, of the U. S. Engineer Corps, officiated. The government has a force of about 100 men employed in quarrying stone and other preliminary work.

The latest thing in tire dressing brake shoes is a shoe with blocks of vitrified corundum imbedded in its face. The shoe is intended for application to engines which give especial trouble from hollow tires, and it is said to wear away the outside flange considerably faster than the ordinary tire-dressing shoe with strips of steel in its face. The shoe is made by the Congdon Brake-Shoe Co.

Tests of the Meneely roller bearing were recently made on the Delaware & Hudson Canal Co.'s Belt Line trains, running between Troy and Albany. Two 4-car trains, each weighing 102 tons, were run 18 round trips (270 miles). The cars of one train had the Meneely bearing. The cars of the other train had ordinary bearings. It is stated that the coal burned by the locomotive hauling the Meneely bearing train was 14,800 lbs. (55 lbs. per train mile). The other locomotive burned 11,100 lbs. (41 lbs. per train mile), an apparent saving of fuel of 25%. A dynamometer test showed that a pull of 3,276 lbs. (32 lbs. per ton), was required to start the train with the plain bearings; and only 252 lbs. (2½ lbs. per ton), was required with the roller bearing train.

An aluminum building is proposed by O. F. Aldis & Co., of Chicago. As planned, the whole front of the building will be covered with sheets of the metal, 3-16 in. thick and 20×48 ins. in size. They will be backed by fireproof material. The amount of aluminum required is estimated at 20 tons. The metal will be an alloy of 90% aluminum to 10% copper and other metals.

MOVEMENT OF WATER OVER A DAM WITH WIDE HORIZONTAL TOP.

By Jos. P. Frizell, M. Am. Soc. C. E.

The head h′ at the upstream crest of the dam, being the height of water in the pond or reservoir above the top of the dam, divides itself into two parts (1) h′ — h, which imparts velocity to the water, and (2) h, which determines the cross section of the issuing stream. The real problem is to find in what proportion this division takes place. We will not, in this case, take account of frictional resistance or the loss of head occurring at the upstream crest from the contraction incident to sudden change of direction. Consider only a unit length of the dam. The flow of water will be represented by the formula

$$Q = h\sqrt{2g(h' - h)} \qquad (1)$$

Q being the discharge in cubic feet per second, g the acceleration of gravity per second: It is manifest that the value of Q will range between wide limits according to the proportion in which h′ divides itself.

It appears to me that the ratio of this division is simple and obvious. The discharge Q is determined

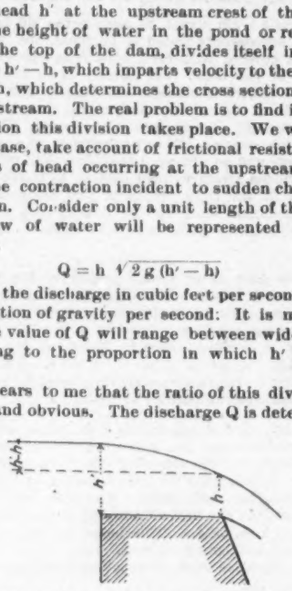


Diagram Illustrating Movement of Water Over a Dam with Wide Horizontal Top.

by the depth h′, and will be the greatest that can occur with that elevation of the surface. The ratio between h′ and h must be consistent with that condition. In other words, Q will be a maximum with reference to h, and we shall have

$$\frac{dQ}{dh} = 0 \text{ (zero)} \qquad (2)$$

From (1) we have:

$$Q^2 = h^2 \times 2g(h' - h)$$

$$\text{and } Q\frac{dQ}{dh} = 2gh(h' - h) - gh^2$$

whence by (2):

$$2gh'h = 3gh^2 \text{ and } h = \tfrac{2}{3}h'$$

from which it appears that ⅓ of the head h′ is expended in generating velocity, the remaining ⅔ determining the cross section of the stream.

The discharge will be per lineal foot of dam:

$$Q = \tfrac{2}{3}h'\sqrt{2g\frac{h'}{3}} = 3.09\,h'\sqrt{h'} \qquad (3)$$

The ordinary formula used in this country for the flow over an ideal weir, i. e., with no sensible thickness of crest is

$$Q = 3.33\,h'\sqrt{h'}$$

giving result a little greater than (3), as might be expected.

This formula is here published for the first time.

Applying this formula to the case of the dam at Austin, Tex., with h′ = 15 ft., we should have h = 10 and h′ — h = 5, whence the horizontal velocity,

$$v = \sqrt{5 \times 2g} = 17.9 \text{ ft. per second.}$$

not 25 ft., as given by Mr. Fanning, in his report to the city of Austin.

The discharge would be 17.9 × 10 = 179 cu. ft. per second per unit length of dam, or 179 × 1,150 = 205,850 cu. ft. per second for the entire dam.

The formula (3) would seem to be more reliable for the case in question than the ordinary weir formula, which is empirical, and not to be trusted much beyond the limits of the experimental data on which it rests.

It is not probable that formula (3) could be applied to a case in which the depth h′ much exceeds the width of the top of the dam.

As a test of this formula we may make the following comparison of the results which it gives for the ow of water over a wide crested weir with results of experiment.

Mr. James B Francis, of illustrious memory, made in 1852 five experiments on the flow of water over a wooden dam of the Essex Company at Lawrence, Mass. The water passing over was measured in the chamber of a canal lock specially arranged for that purpose. The dam was about 3½ ft. wide on the crest and sloped up stream with an inclination of 3 base to 1 perpendicular. The experiments were conducted with all the accuracy which characterized that distinguished experimenter. (See Lowell Hydraulic Experiments, 1868, p. 136.) The results are given below. The formula gives a little higher quantities than the experiment, as might be expected since it takes no account of friction.

	Depth in ft. on weir 9.995 ft. long.	Quantity in Cu. ft. per sec. By experiment.	Frizell's formula.	Diff. p. c.
Expl. No. 1.....	0.587	13.385	13.88	+ 3.7
2.....	0.790	20.892	21.68	+ 3.8
3.....	0.977	28.914	29.81	+ 2.9
4.....	1.325	46.183	47.68	+ 1.9
5.....	1.634	64.346	64.48	+ 0.2

COST AND METHODS OF PAYING FOR MUNICIPAL IMPROVEMENTS, STREET CLEANING AND SPRINKLING.

The subject of assessments for municipal improvements and of different methods of street cleaning and sprinkling has recently been reported upon at length by Mayor Hempstead Washburne, of Chicago, in the form of a message to the City Council. In gathering information Mr. Washburne was assisted in his investigation by a gentleman who visited some cities to obtain facts at first hand, both for the sake of accuracy and to aid in formulating a course of speedy action, to ward off so far as possible danger from the cholera. The investigation in itself is so creditable an undertaking for the mayor of a large city and the data gathered seem so reliable, that an abstract of the message is given below. It may first be stated that in our issue of March 21, 1891, a digest was given of the ways by which money is raised for street improvements in New York, Philadelphia, Boston, Buffalo, Providence, Baltimore, Cincinnati, St. Paul and St. Louis, so that much of the information in Mayor Washburne's message relating to New York, Philadelphia and St. Louis need not be repeated. In our issue of Oct. 24, 1891, a digest was given of the general street law of California and the law was commented upon editorially. In our issue of June 2, 1892, a description was given of the street sprinkling methods now employed in Boston, with details of cost.

Some of the interesting facts in the message which may be new to our readers are as follows:

In Chicago, special assessments against abutting property are levied for sewers, house drains, sidewalks, lamp posts, street and alley paving, water mains and water service pipes. For some reason, not plainly indicated in the report, the assessments, which are levied before the work begins, are in excess of the cost of the work, necessitating rebates after the work is completed and often depriving property owners of the use of considerable sums of money for several months. In addition to this, defect in the method it has been possible for property owners to secure from the City Council a "stay order" which may either delay or entirely stop improvements under way. The city pays its contractors in warrants instead of in cash, and as the warrants can be realized on only at a discount, the work of the city is not done on a cash basis.

At Minneapolis the assessments are also based on estimates, but the estimates are so close that rebates are seldom necessary. The assessments are payable in five annual installments, bear 6% interest, and go into a "Permanent Improvement Revolving Fund," against which are issued 4½% 30-year bonds, which are marketable at par.

Regarding street cleaning, Mayor Washburne states that of the six cities, New York, Chicago, Philadelphia, St. Louis, Minneapolis and Indianapolis, the latter is the only one which pays for street cleaning by special assessment. This method has been in vogue at Indianapolis for several years and is said to be satisfactory. The work is done by contract, the cost in 1891 having been 44 cts. per 10,000 sq. ft., each cleaning, for wood and brick, and 34 cts. for asphalt pavements. Frequency of cleaning varied from weekly to daily. The cost to property owners for the whole season June 1 to Dec. 31, 1891, varied from 2 1-6 to 10 cts. per front foot, depending upon material and width cleaned. Macadam streets in both Indianapolis and St. Louis are cleaned only once a year, it is stated.

At St. Louis the streets are cleaned under three-year contracts. Most of the sweeping is done by machines, between 10 p. m. and 7 a. m. All piles of sweepings must be removed from the streets within two hours. The sweepings are hauled about four miles to barges and finally dumped into the river. The present contracts for street cleaning in St. Louis are as follows: Granite and wood pavements, 48 cts. and asphalt, 38 cts., each cleaning, per 10,000 sq. ft. The entire cost of street cleaning in St. Louis, including administration and care of barges was about 60 cts. each cleaning, per 10,000 sq. ft., or $11.40 per mile of 36-ft. roadway, material not stated.

In Philadelphia, in 1891, the average cost per mile for street cleaning, removing ashes, garbage and dead animals, was $11.47 per mile, the work having been done by contract.

In Chicago, in 1891, the cost of cleaning 7,160 miles of streets (frequency not stated) and "doing an unknown amount of scavenger work and removing dead animals" was $544,386, or an average of $27.50 per mile. This is high as compared with the figures for other cities compiled by a special New York commission, which in 1891 reported that the streets were cleaned in New York for $20.00 per mile; in Philadelphia for $11.47; St. Louis, $9.12; Indianapolis, $8.36; Buffalo (asphalt), $7. Of course it will be understood that in these figures no account is taken of the width of street and perhaps several other dissimilarities.

Chicago is absolutely without street sprinkling, at least so far as city service goes. At St. Louis, Indianapolis and Minneapolis the streets are sprinkled by special assessment.

At St. Louis about 450 miles of streets are said to be sprinkled four times a day for six days and three times on Sunday, the service extending from March 15 to Dec. 1. The work is done by contract, there being a separate contract for each of the 45 districts. In 1891 the average cost of sprinkling per front foot of abutting property was 3½ cts. There are 20 inspectors, in addition to the whole police force, to see that the work is properly done. For each omission of sprinkling a proportionate deduction is made from the contractor's monthly payment. In one year these deductions amounted to $48,000, but the next year, as might be expected, the amount of deductions was small. In this connection it may be stated that the contractors for street cleaning once attempted a combination. All bids were rejected by the Street Commissioner as too high. The Commissioner at once had introduced in the City Council an ordinance empowering him to supply any street cleaning contractor with the necessary plant, the cost to be deducted from the monthly payments. New bids were asked and the combination was broken, the tenders being much lower than those received at the first letting.

About 70,000 special assessment bills for sprinkling are required annually in St. Louis. These bills were made out last year in two months' time by a temporary force of clerks in the Tax Commissioner's office at a cost of only $1,948. The assessments are collected with the other city taxes. The estimated amount of water used for sprinkling in St. Louis in 1891 was 4,000,000 gallons daily. Water is furnished by the city without charge. The contractors are paid directly from the city treasury each month.

At Indianapolis 70 miles of streets are sprinkled three times a day from April 1 to Nov. 1. The work is done by contract and its average cost in 1891 was 7½ cts. per front foot of abutting property.

At Minneapolis contracts for street sprinkling are let by wards by the aldermen of the respective wards. City officials make out and collect the assessments and pay the contractors. The cost per front foot on unpaved streets ranged in 1891 from 2 to 7½ cts., averaging 5⅓ cts. for the season. On paved streets the average cost was 6½ cts. and the range from 4 to 7 cts.

In closing Mayor Washburne calls attention to the need of compulsory measures by the city Health Department for the removal of stable manure and for the maintenance of all stables in a cleanly condition. To "the heaps of decaying refuse which lie in every alley in Chicago" Mr. Washburne attributes a large proportion of the deaths from both typhoid fever and diphtheria, thus shifting a part of the blame from the water supply, to which it is more generally and certainly more justly attributed. Doubtless, however, decaying stable manure contributes somewhat to cause typhoid fever, but in an indirect way, although Mr. Washburne states that

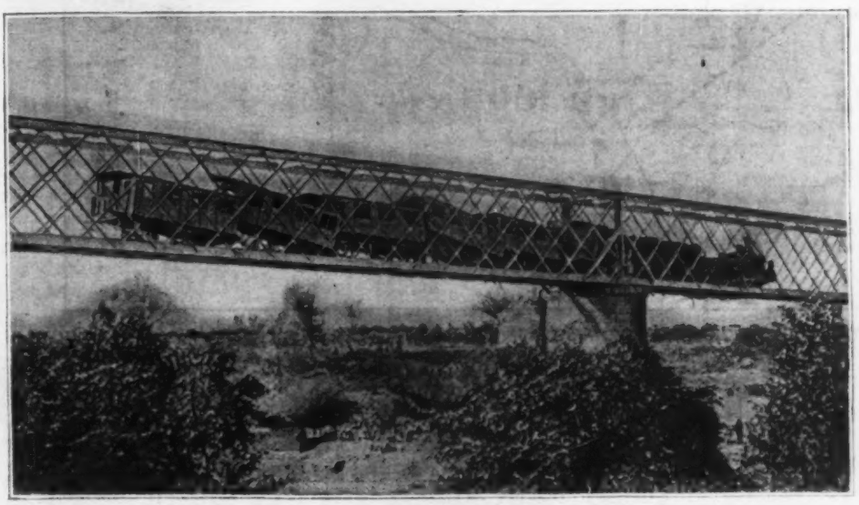
"exhaustive researches by Dr. Cyrus Edson, of the New York Health Department, prove that to the presence of rotting stable manure in the alleys is due the greater proportion of cases of typhoid fever and diphtheria." Since writing the last sentence we have received a letter on this subject from Dr. Edson which does not substantiate the statement attributed to him. It is given at the close of the editorial in this issue, "Cholera as a Sanitary Agent."

In New York, the message states, manure from all stables is removed between 4 and 7 a. m. by a private concern under supervision of the Health Department. The manure is said to be packed in tightly covered barrels in the stables and removed in tightly covered carts.

Mention of one more interesting point made in the message should not be omitted. It is stated that in St. Louis the cost of engineering and inspection is (sometimes?) less than 2%, while in Chicago it ranges from 5 to 15%.

ACCIDENT ON THE ORB BRIDGE, FRANCE.

We are indebted to "Le Genie Civil" for the somewhat meagre details of the peculiar derailment which is illustrated herewith. The derailment took place on the Bridge of l'Orb near Lignan, on the railway line from Beziers to Saint-Chiman, France. The general view of the train and bridge after the accident, which resulted in the death of four and the injury of 50 persons, is shown in the illustration. It will be seen that the locomotive after leaving the track crushed into the right side truss of the bridge and came to a stop, telescoping the cars in the rear. These were ten in number, three of which were loaded with hay and the remaining seven, which were passenger cars, carrying altogether 150 passengers. As the bridge is but a short distance, 800 m., or about one-half a mile, from the station at Lignan, the train was probably not running very fast, which undoubtedly accounts for its not crushing through the bridge and increasing the number of deaths and injuries. With the heavier cars of this country the danger of breaking through the bridge would have been increased, but at the same time had the train remained on the bridge there would have been no such telescoping of the cars as is shown here. As near as can be ascertained at present the derailment was caused by the moving or spreading of the rails on account of a defective girder. Further than this little will probably be known until after the official investigation of the accident.



RAILWAY ACCIDENT ON THE ORB BRIDGE, FRANCE.

THE NOMENCLATURE OF ASPHALTIC AND BITUMINOUS PRODUCTS.

We have received from Mr. Leon Malo, Consulting Engineer, of Seyssel, France, an article on the "Nomenclature of Asphaltic and Bituminous Products" in which he urges that to avoid confusion of terms he adopted a nomenclature twenty-five years ago to which no objections were made until 1888, when Capt. F. V. Greene, in a paper before the American Institute of Mining Engineers, read at Buffalo, N. Y., objected to Mr. Malo's use of the word asphalt to designate a natural combination of bitumen and limestone only. Mr. Malo's article, it should be added, was translated by Mr. W. H. Delano, Paris.

Mr. Malo classifies bitumen according to its combination with other materials, as follows:

(1) When bitumen impregnates limestone by a natural process the product is asphalt. (2) When bitumen agglomerates quartzous or quartzo-calcareous sand, the product is bituminous sand. (3) When it is mixed with clay the product is Trinidad Lake pitch. (4) When mixed with bituminous lime stone (i. e., asphalt), melted and run into blocks, such as are used for sidewalks, the product is bituminous mastic."

Mr. E. P. North, M. Am. Soc. C. E., in a paper on "Construction and Maintenance of Roads," read before the American Society of Civil Engineers, April 16, 1879, and since published in the book entitled "Road-Making and Maintenance," says that asphalt and bitumen have been used as interchangeable terms by dictionary makers and chemists. He then gives definitions of these words and of asphaltic mastic by Mr. Malo, as follows:

Asphalt; bituminous limestone.

Bitumen; the black and viscid substance which we find disseminated in the pores of bituminous limestone and in the interstices of the "mollasses"* of Seyssel or the sands of Auvergne.

Asphaltic mastic; bituminous limestone transformed by dressing and by the addition of a small quantity of bitumen.

Mr. North states that "it is believed" the above definitions have been generally accepted in Europe and employs the words with the same meaning in his paper, with the exception that the bitumens from Trinidad and Cuba are included. To cover American practice Mr. North added the following definition:

Bituminous Mastics.—Mixtures of bitumen, either having an earthy "gangue," like those of Trinidad and Cuba or purer ones, like Grahamite and Albertite, with limestone or other substances not naturally impregnated which add to its resistance to wear.

The facts of the case seem to be that Mr. Malo's restriction of the word asphalt to designate bituminous limestone, or natural rock asphalt, answered very well in Europe, where bituminous limestone was chiefly used, but in this country we have not found it convenient or in any way desirable to restrict a word of universal application to the bituminous products of one locality. It is not easy to see why bitumen naturally combined with limestone should be called asphalt, while the same material in larger proportions combined with alumina and silica, oxide of iron and lime, the chief mineral components of the Trinidad product, should be called Trinidad Lake pitch. In its earliest use the term asphalt was applied to the bituminous matter itself and not to a combination of this with any one mineral. From this point of view the Trinidad product, far more than that of Seyssel or Val de Travers, is worthy of the name asphalt, since it contains about four times as much bitumen. Natural asphalt sandstone rock is now found in California (Eng. News, Jan. 8, 1887, Nov. 30, 1889), so any claim to the exclusive use of the term asphalt to the bituminous limestone of France or Switzerland because this is more nearly ready to be put into pavements is not now, if ever, valid.

The word asphalt in various forms is found in the Greek, Latin, Italian, French, Spanish, Provencal and Middle English languages. It is of undetermined foreign origin, but has been employed from the earliest times to designate bituminous products used as cements.

The Century Dictionary defines "asphalt" as nearly synonymous with "bitumen." We see no reason for questioning the propriety of this definition, nor for attempting to restrict the single word "asphalt" to what is now generally described as "natural rock asphalt." Certainly this is not now the popular meaning attached to the word. Every one thinks he has some idea of what "asphalt" is, and yet a majority, perhaps, of intelligent men who are not engineers do not know even that there is such a thing as natural rock asphalt, having rarely or never seen the rock itself.

*Mollasses is old French for soft sand-stones. It is a local word.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Changing Course of Surface Water.

In an action against a railway company for building an embankment and culvert, which diverted the water from ordinary rains and caused it to overflow and injure a person's land, a defense, showing that such person had warning of the danger, and could at slight expense have prevented the overflow by cutting a ditch on the line of his land, is not sufficient, if it is not further shown that by cutting the ditch he would not have injured contiguous land. (Austin & N. W. R. Co. v. Anderson. Supr. Ct. Tex., 19 S. W. Rep., 1025.)

Tide Lands and Harbor Lines.

A littoral landowner cannot assert title to land lying below the line of ordinary high tide, as against the state, in the absence of a license from the state. The clause in the constitution providing that the legislature shall provide for a commission to establish harbor lines in navigable waters of all harbors in the state within or in front of corporate limits of a city or within a mile thereof, and shall provide for the leasing of the rights to build and maintain wharves, etc., does not recognize any rights in riparian owners to tide lands unless under licenses from the state, and the commission may include such lands within the harbor lines. Where a riparian proprietor has no right of title to tide lands, simply owning the wharf thereon, including such lands within the harbor lines, is not such an interference, ownership or possession of the wharf as will authorize a court to issue a writ of prohibition. If the laying of such lines was in violation of the acts of Congress concerning navigation and harbor lines, the United States, by its proper officers, alone can interfere. (State v. Prosser. Supr. Ct. Wash., 30 Pac. Rep., 734.)

Location of Certificate and Estoppel.

In an action by the purchasers of certain land from the State of Texas against persons claiming under locations of prior certificates, it appeared that the first certificate was located by starting at a known point on a certain river and running south a certain distance, thence west 950 varas and thence north to the river so as to inclose 640 acres. Each succeeding block was located in a similar manner; starting from the northwest corner of the preceding block, and specifying the river as the north side. Under these circumstances where by reason of a sharp turn in the river toward the south, of which the surveyor was not fully advised, and for which allowance was not made in the field notes, a certain block lay between two and three miles north of the river if placed according to the call for the corner of the preceding block, or did not adjoin such block at all if placed south of the river, the call for the river must prevail; and the question whether a subsequent attempted correction of the survey, so as to make the river the north boundary, was void, as a relocation instead of a correction, would depend upon whether it embraced land not embraced in the first field notes. The purchasers, who were partners of the surveyor and assisted in making the survey, were estopped, as trustees for the claimants under the certificates, to set up their claim to the land; and the fact that the partnership was not known, and that the contract for the survey was wholly with the surveyor, did not make their relation less fiduciary than it would have been had the contract been with them. (Sanborn v. Gunter. Supr. Ct. Tex., 20 S. W. Rep., 72.)

Liability of City for Engineer's Act.

A city is liable for injuries caused by an obstruction in a sewer which was placed there under the supervision of the city engineer, or of which he had actual or constructive notice. (Kinsel & Co. v. Ogden City. Supr. Ct. Utah, 30 Pac. Rep., 758.)

Navigable Water as Boundary of Street.

Where, upon a town plat, a street is laid down, and the boundary for part of the street on one side is a navigable lake or river, the street extends to low-water mark, and the dedication will be held to have been intended to enable the public to get to the water for the better enjoyment of the public right of navigation. (Village of Wayzata v. Gt. No. Ry. Co. Supr. Ct. Minn., 52 N. W. Rep., 913.)

A City's Authority Over Street Grade.

A city council having general authority to establish the grades of streets may, under peculiar circumstances, fix the grade for one side of a street on a materially different level or place from that of the other side; and if this renders it incidentally necessary to construct a retaining wall along the center of the street to support the earth on the higher grade, that may be done. Such an exercise of public rights is not an infringement of the rights of an adjacent proprietor, whose property may be injured thereby. (Yanish v city of St. Paul. Supr. Ct. Minn., 52 N. W. Rep., 925.)

IRRIGATION SYSTEM OF THE CUCAMONGA FRUIT LAND CO., SAN BERNARDINO CO., CAL.

By Geo. F. Wright, M. Am. Soc. C. E.

The lands covered by the system are located in what is known as the Foot Hill Belt, 43 miles east of Los Angeles, and 20 miles west of San Bernardino. There are 9,000 acres in the tract, practically

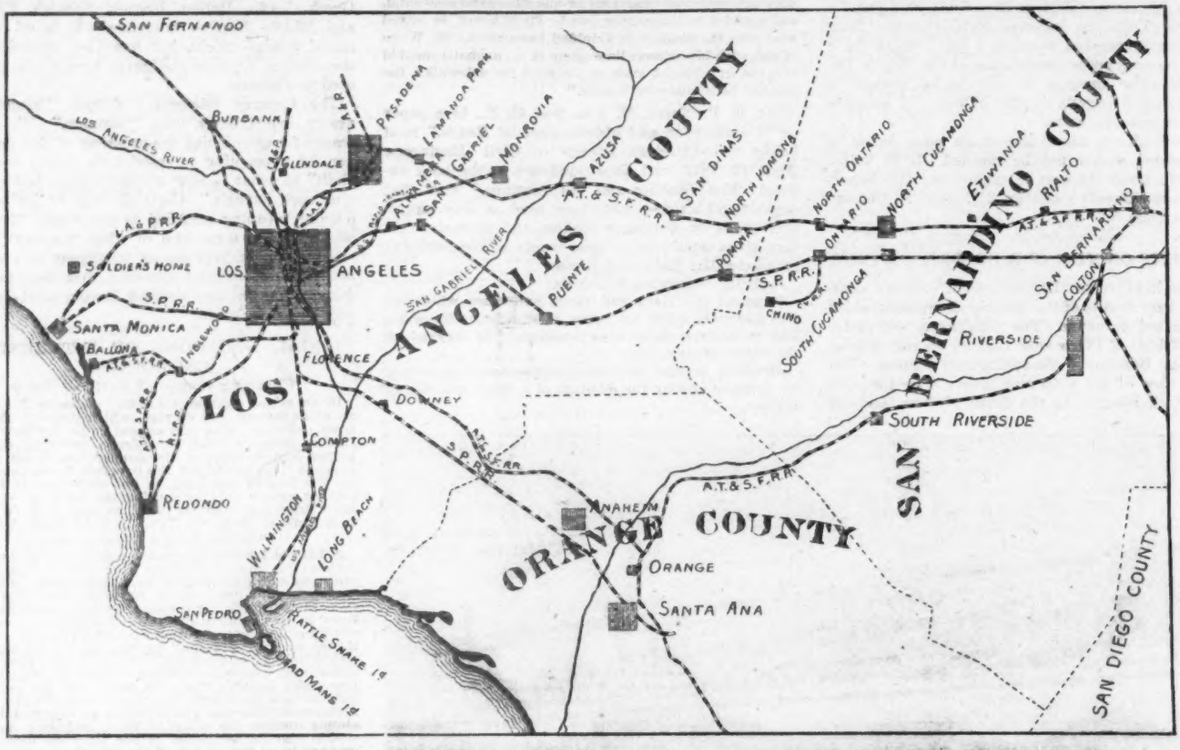


FIG. 1, MAP OF PART OF CALIFORNIA SHOWING LOCATION OF IRRIGATION SYSTEM OF CUCAMONGA FRUIT LAND CO.

under the same system, though not all under one ownership.

The tract is ideal from the Californian's point of view, in that the water all rises and, in its natural flow, sinks within its boundaries, and is therefore free from contests of "riparian owners" and the "water claim" fiend who has retarded or killed so many meritorious schemes under the prior appropriation law.

Fig. 1 shows the relative location of the tract and railways from Los Angeles to San Bernardino. Fig. 2 shows the portion covered by the system and the general topography.

The elevation at the Southern Pacific Ry. station is 950 ft. above tide water. From this point going north the ground rises at the rate of 75 ft. per mile for two miles. In the third mile the rise is 100 ft. and the fourth and last mile 150 ft. These slopes are practically uniform in each mile, the irregular surface being on the east and west lines, but nothing excessive in any direction.

The storm water drainage from the Sierra Madre Mts., distant two to three miles north, has cut a channel on the east to the boulders underlying the district on that side, the surface soil being from 4 to 6 ft. deep. The Cucamonga Creek, always a living stream in the mountains, having its source near the summit, during the heavy winter rains becomes a raging torrent, which has cut a wide and deep channel on the west side of the tract.

The Sierra Madre range is very rough and precipitous, rising in six miles to a height of 8,500 ft., and continuing to the top of San Antonio Peak (Old Baldy) 10,100 ft. The range is double, the streams rise near the summit of San Antonio Peak, running thence east or west parallel with the course of the main range, finally breaking through the southerly ridge and into the valley.

The formation is of granite, the south slope being practically destitute of timber except in the canyons. The soil of the foot hills and mesas is a reddish loam, growing more sandy as it approaches the valley.

Source of Supply.

The source of water supply is primarily the Cucamonga Creek and its drainage area. The living stream, except during storms, sinks before reaching the plain, running thence underground at unknown depths until brought to the surface a short distance below the San Bernardino base line by a clay dike stretching across the underground channels in an

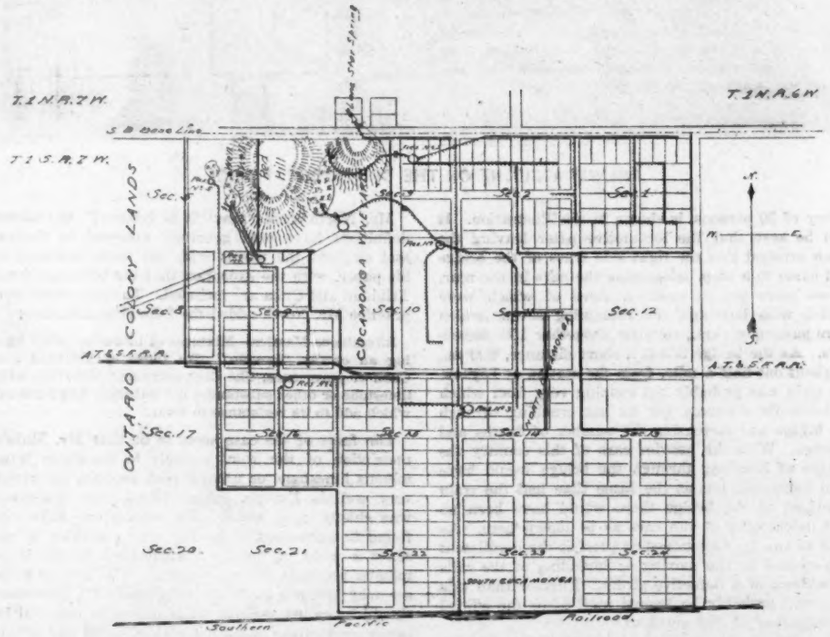


FIG. 2. IRRIGATION SYSTEM OF THE CUCAMONGA FRUIT LAND CO.; E. T. Wright, Engineer.

east and west direction, being on the surface from half to three-quarters of a mile wide north and south and one mile long east and west.

The water rises in two cienagas separated by the "Red Hill," so-called from its color, being a conspicuous landmark from the valley. This hill contains a fine grade of clay which has been extensively used for brick making in the past.

The cienagas both head but a short distance below the base line, the eastern containing about 60 acres and the western 40 acres. The surface is not level, but falls rapidly toward the south, the water rising all over the surface and running off rapidly after reaching the several channels which have been kept clear of rushes and willows by the action of the water itself.

Toward the lower end of the "Red Hill," springs break down some 25 or 30 ft. above the cienaga at that point, which seems to prove that it is this clay which is alone responsible for the appearance of the water above it. No springs show themselves in the clay but all are above.

The natural flow from these cienagas in 1885 was 4½ cu. ft. per second from the eastern and 1½

cu. ft. per second from the western, making a total of 6 cu. ft. per second, which is equal to 300 statutory miner's inches (4-in. head). All contracts in this district and Southern California generally are made with this "miners' inch" as the unit, and in this article all measurements will be given in inches.

In addition to these cienagas a small supply is obtained by development of a small spring lying above the base line and purchased for the purpose of covering a portion of the tract too high to reach from the other sources. The supply from this spring and tunnel development is 15 inc., reaching the highest point in the tract with a 20-ft. head.

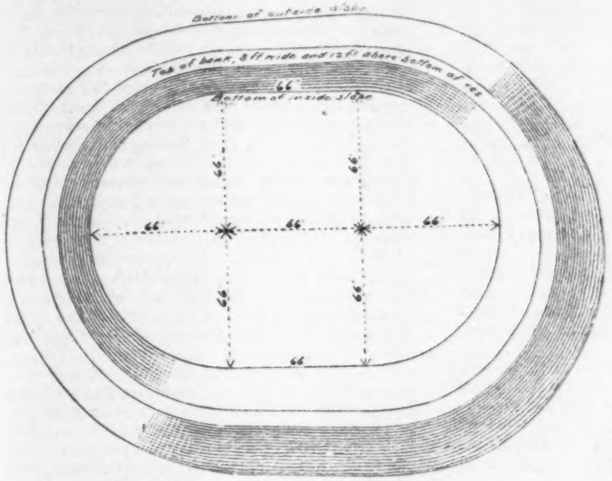


FIG. 3. PLAN OF RESERVOIR NO. 1.

There are three separate interests supplied from this source. The Cucamonga Vineyard Co. owns 1,160 acres and one-half of all the water flowing or which may be developed in the east cienaga. The Cucamonga vineyard is one of the oldest in the State, some portions of it having been in vines for 40 years, many vines of the original tract being still bearing and a part of the present vineyard. A large and successful winery has been in operation here for 30 years or more. Port is the principal wine on which its reputation is maintained, being for some reason of soil, climate or manufacture of a high grade of its class. Its sherry and angelica wines also rank among the best.

The Cucamonga Colony own 900 acres, its title being derived from the same source as that of the Fruit Land Co. The water rights sold with this land have in most cases been merged in the Cucamonga Water Co. The owners of about one-third the amount would have nothing to do with a company except on their own terms, so that their quota of water is set off to them as described hereafter.

The Cucamonga Fruit Land Co., organized in 1885, owns the remaining land and water subject to sales made in harmony with the general plan of distribution. This company was composed of five members originally, each owning equal interests. One of the members has since sold half of his interest.

Distribution System.

The plan of distribution is to pipe the water from the different sources of supply to distributing reservoirs of between 2,000,000 and 3,000,000 gallons capacity, so located that each reservoir will cover its proportional area.

There are five of these large reservoirs and one small one of 500,000 gallons capacity. The design is the same for all. Fig. 3 gives a cross section and plan of reservoir No. 1. The earth is excavated from the bottom to form the banks, the latter being made without cores of any kind and no puddling of sides or bottom. Very little leakage was noticed and that little was stopped after a short time in use, there being enough clay in the soil to act as a good puddle material. Fig. 2 gives the location of reservoirs in the tract. Reservoir No. 1 is supplied through a 16-in. concrete pipe, 4,400 ft. long, leading from the upper end of the east cienaga and the tunnel development therefrom. This reservoir supplies all of sections 1 and 2 and that portion of section 3 lying below it, in all amounting to 1,500 acres including roads. The distribution pipes from this reservoir are all of riveted wrought iron thoroughly coated with asphalt inside and out, comprising in all 13,200 ft. of 8-in., 1,350 ft. of 7-in., 1,450 ft. of 6-in., 13,450 ft. of 5-in., and 15,200 ft. of 4-in. pipe.

Each lot is within reach of its respective hydrant without crossing any other lot. Pressure pipes are used in this division entirely.

Reservoir No. 2 draws its supply from the lower end of the main east cienaga through 1,000 ft. of 30-in. cement pipe, to the division box between the Vineyard and Fruit Land Co's. division box for the Cucamonga Colony, thence by 2,500 ft. of 16-in. cement pipe to the reservoir.

The upper supply system is also connected with reservoir No. 2 by an 8-in. cement pipe leading south in a road through the center of Section 3. This reservoir (No. 2) supplies the east half of section 10, all of section 11 and the north half of section 14. This includes the townsite of North Cucamonga. This division is also laid with pressure pipes comprising 3,600 ft. of 8-in., 7,000 ft. of 6-in., 10,750 ft. of 5-in., and 9,240 ft. of 4-in. pipe. The 5-in. main running south between sections 2, 3, 10, 11, 14 and 15 discharges into reservoir No. 3 when not used for active irrigation.

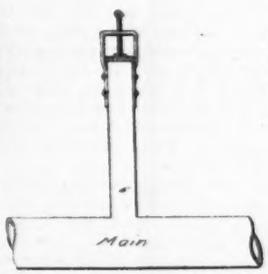


FIG. 4. ORDINARY IRRIGATING HYDRANT.

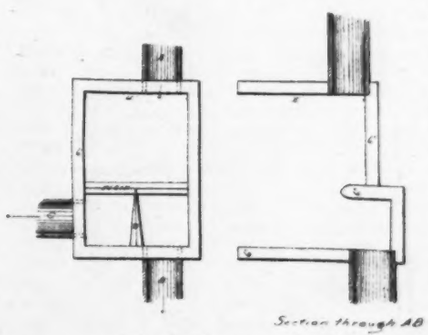


FIG. 5. DIVISION BOX NO. 1, 16-IN. PIPE LINE.

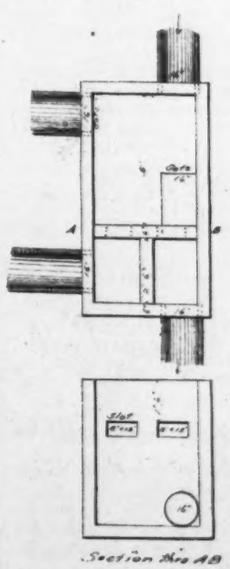


FIG. 6. DIVISION BOX NO. 2, 16-IN. PIPE LINE.

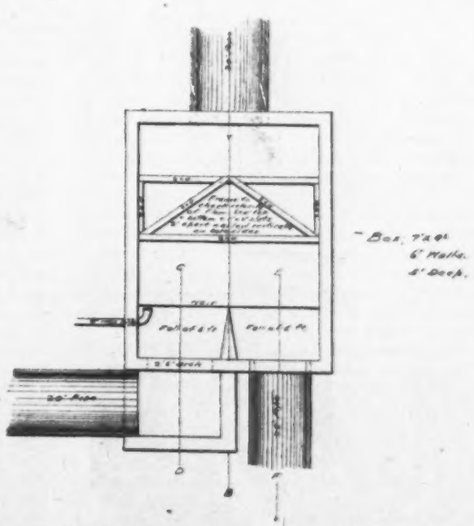


FIG. 7. PLAN OF LARGEST SIZED DIVISION BOX, CUCAMONGA FRUIT LAND CO.

Reservoir No. 3 is supplied by the 5-in. main from No. 2 and also by a cement pipe of 16-in. and 10-in. diameter leading from reservoir No. 6; the sole duty of No. 3 as at present developed is to furnish the townsite of South Cucamonga with water, the contract calling for 30.8 ins., which is delivered through 3,300 ft. of 6-in., 2,300 ft. of 5-in. and 2,970 ft. of 4-in. iron pipe.

Reservoirs Nos. 4, 5 and 6 are supplied from the western cienagas and the water developed by tunnel. No. 4 is supplied through 3,300 ft. of 16-in. cement pipe connected with the cienagas direct and also with 1,000 ft. of 16-in. pipe leading from the portal of the tunnel. A 16-in. cement pipe connects with reservoir No. 6, one mile south, and an 8-in. cement pipe leading from the tunnel runs north and south ¼ mile west of the 16-in. pipe emptying into the 16-in. pipe just above reservoir No. 6.

Reservoir No. 4 supplies all of section 9 owned by the Fruit Land Co., there being 5,000 ft. of 16-in., 3,300 ft. of 6-in. and 6,600 ft. of 8-in. pipe, all cement.

Reservoir No. 6 covers section 16 except the westerly 160 acres supplied from No. 5, and so much of section 15 as it is contemplated using at present. This is done by 2,600 ft. of 16-in., 9,240 ft. of 10-in. cement pipe and 2,640 ft. of 8-in. iron pipe, 1,000 ft. of 6-in. and 3,300 ft. of 5-in. iron pipe.

Reservoir No. 5 is located near the west side of the west cienaga and is supplied from two artesian wells and a small ditch run into the cienaga some 400 ft. In running this ditch an old reservoir was discovered, the existence of which was previously unknown notwithstanding that parties now residing on the tract have lived there for 50 years.

Reservoir No. 5 is the smallest on the tract, having a capacity of about 500,000 gallons. The supply furnishes 31 ins. steady flow, which is more than ample for all present demands.

The pipe from this reservoir leads due south and is an 8-in. cement pipe for 3,000 ft., then a 6-in. iron pipe for 8,000 ft., terminating in a dead end, as do all other north and south lines below the line of reservoir No. 3. The small portion, about 70 acres of sections 2 and 3, lying about reservoir No. 1, is supplied from the Lone Star Tunnel through 4,500 ft. of 4-in. iron pipe running along the base line.

The gates from reservoirs used are mostly the Chapman straightway valves.

The irrigation hydrants are very simple, being (on iron pipes), a 4-in. pipe connected with the main by

vertical T's. The valve consists of a circular piece of board pressed down on the edge of pipe by the action of a screw till the flow ceases, see Fig. 4. This is the hydrant most in use in this state; it is cheap and simple, but when on pipes with any material head, the operator is in some danger of getting wet. This is remedied most commonly by driving the valve stem through the bottom of a 5-gallon kerosene can inverted over the hydrant; this idea has

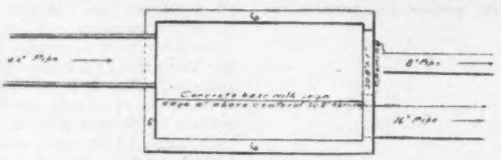


FIG. 8. DIVISION BOX USED BY SETTLERS NOT IN WATER COMPAYY.

been utilized in hydrants of recent date, which are constructed to direct the flow into the irrigating flume or ditch without so much preliminary commotion.

On lines of cement pipe the gate is inserted in the main below the consumer's ditch, the water then rises and flows as directed, during the period allotted to the individual using it. This is under the control of the zanjero or superintendent who has entire charge of the company's pipes, reservoirs and irrigating hydrants.

The amount of water in this district sold with the land is 1 in. to 10 acres. An amount equal to a steady flow of 1 in. to 10 acres is turned into the individual's irrigating pipe or ditch two or three times per month; the measurement and selection of days are under the control of the zanjero. The domestic supply on cement lines is stored in cisterns from one irrigation day to the next. On pressure lines the service pipes are connected with the mains.

A small monthly charge is made for domestic supply. The only charge for irrigating service is made for each day the water is used; this charge is made to pay the zanjero and for paying general operating expenses and varies materially with the location. At Cucamonga the charge for domestic water is $1 per month, for irrigation 50 cts. per head of 25 ins. There are now 2,700 acres being irrigated in vineyard, citrus and deciduous trees. The system has been in use for six years without a break of reservoir bank or serious stoppage of pipe. The only weakness in the design manifest is in the small size of the long main, between sections 2, 3, 10, 11, 14 and 15. While this has proved equal to all demands up to the present, the increasing demand, as the trees grow older and new areas come in for irrigation, will undoubtedly call for a new pipe of larger diameter in the near future.

The division of waters between the Vineyard and Fruit Land Cos. has necessitated three different division boxes, two on the upper 16-in. pipe line and one at the head of the 22-in. pipe line. Figs. 5 and 6 show the boxes on the upper line and Fig. 7 that on the 22-in. line. All the boxes are made of concrete with 6-in. sides and bottoms. The box shown in Fig. 5 is seldom used, the idea in the devices shown by Figs. 5 and 6 being to make an equal division simply. Fig. 7 shows the largest and best box in the system.

The drawings explain themselves with the exception of the 2-in. iron pipe shown on the left of the weir in the plan of Fig. 7. The mouth of the elbow is turned up so that it is directly under the weir fall, and supplies the store and a small piece of land with "what water will flow through a 2-in. pipe."

Fig. 8 shows the division box between the Fruit Land Co. and the settlers who would not enter the Water Co.

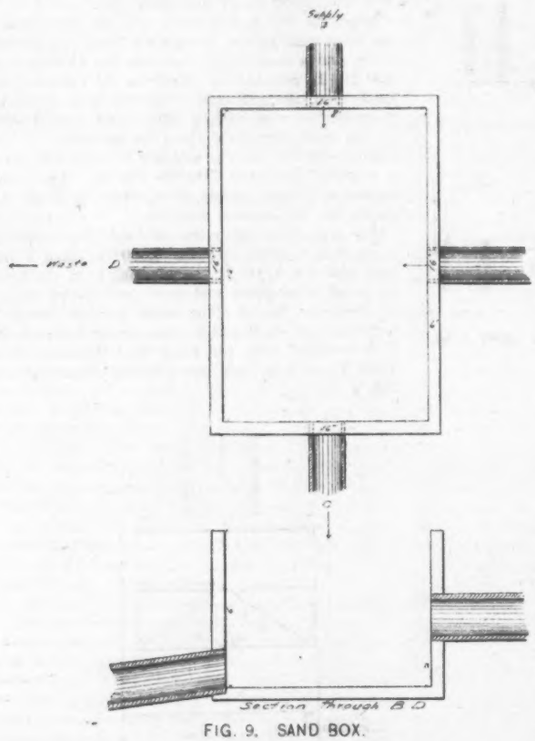


FIG. 9. SAND BOX.

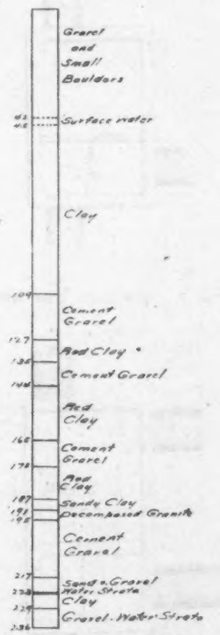


FIG. 10. STRATA PIERCED BY ARTESIAN WELL NO. 1.

Fig. 9 shows the sand box which is almost universal in California irrigation systems. This box is located at the head of the upper 16-in. pipe line, the inlet and outlet pipe all being at a considerable distance from the bottom, the waste pipe flush with the floor.

Development.

It has been shown that the total supply from surface flow in 1885 was 300 ins. of water of which the Cucamonga Vineyard Co. owned 112.5 ins., leaving 187.5 ins. with which to irrigate 7,000 acres, which would require a minimum supply of 700 ins. It was the expectation of the company that the additional flow could be obtained by cross trenching the cienagas and cleaning out and deepening the natural channel. The result of this cross-trenching was a surprise, the trenches were dug 2 ft. wide by about 3 ft. deep, and, according to the previous experiences elsewhere, should have concentrated the water in the ditches and dried up the surface. It was found that with two parallel ditches 25 ft. apart the major portion of the original surface between ditches remained wet and marshy, and the increased flow into the ditches was not large enough to warrant the belief that the required supply could be obtained in this manner. As the water had to be obtained, a large ditch was started in the cienaga some distance above the head of the upper pipe line; this ditch was run at a lighter grade than the natural surface of the cienaga and parallel with the channel of the stream. As the depth of this ditch increased the water began to come in from the sides and bottom in considerable quantities, oozing out, apparently over the entire surface, and not through a few definite channels, as one would expect from the nature of the material. This ditch was continued until a depth of 24 ft. was reached, the flow increasing with the depth below the surface. It is worth mention that this wide and deep ditch did not dry up the surface more than a few feet on each side, and at the distance of 25 ft. the decrease was barely perceptible.

From the head of this ditch two tunnels were driven having a common portal, making an angle with each other of 35°. These tunnels were timbered with a clear cross-section of 4 × 6 ft. and were each driven 500 ft. northerly from the portal. The timbers were 6 × 6-in. redwood with 2-in. lagging with open joints. No change in the material was found, the entire excavation in ditch and tunnel being a fine sandy clay thoroughly saturated with water. The timbering was necessarily kept close to the work, but the face of drift stood without protection. The result of this experiment was very satisfactory, the increase in flow while building the tunnels being continuous and large. On one or two occasions a well defined channel was struck, carrying enough water to cause a rapid retreat of the workmen to the open air. A short time sufficed to empty the channel of its stored water, the flow settling down to its normal rate. The total amount of water developed by the two tunnels is 125 ins. in excess of the amount flowing above the intake of the 16-in. pipe line at the commencement of the work. The cost of these tunnels was $10 per lineal foot. It is intended at some future time to extend each of these tunnels to the north line of the property, the supply being ample for present demands.

It is in the west cienaga that the most interesting development work has been done. At the head of the main cienaga, about 500 ft. apart and on opposite sides of the marsh, were driven two artesian wells 7 ins. in diameter, the first well located on the higher ground striking artesian flow at 229 ft., and the second well at 270 ft. in depth. These wells have maintained a permanent flow from their construction in 1887 to date, of 8 miners' inches, or 104,000 gallons each per day. Other wells have been started, but have failed to reach flowing water through accidents to casing or boring tools.

The wells cost each about $1,200, an excessive cost due to the necessity of buying tools and inability to obtain skillful workmen. The record of stratification for well No. 1 is shown by Fig. 10.

It becoming imperative to secure more water in order to keep up with the contracts made and being made, a tunnel was begun at the southwest end of the "Red Hill," east of the wash from the cienaga and 2,000 ft. distant from the lower end, thence running northerly to the cienaga. At this point a hoisting shaft was sunk and a branch tunnel run to the northwest a distance of 500 ft. The main tunnel was continued for 450 ft. There are four minor shafts on the line, serving the double purpose of air shafts and vertical drains of the strata above the tunnel.

Work was stopped at this pomt, as there was a surplus of water above sales made. Nothwithstanding the fact that for the major portion of the length of the constructed tunnel it lies under the hill, and not under the wash or marsh, water began to enter the tunnel from a point 400 ft. above the portal and increased in quantity per square foot of area with the distance from the portal. When work stopped, the flow at the face was increasing so rapidly that

the men were nervous, fearing that they were approaching a reservoir or stream which would be too large to control if it broke into the work.

The design was to put down a series of artesian wells along the projected line of tunnel; cutting the pipes at the floor of tunnel, using the upper sections for air shafts. One well was commenced but it was abandoned without getting a surface flow, owing to bent casing. The pipe of this well was cut when reached and gives a steady flow at the level of tunnel, the amount not being definitely known. The floor of the tunnel at the two upper wells will be 125 ft. below the surface.

When the development work is resumed the original design will be carried out. The result of the experiment with the artesian wells will be of interest to the engineering profession, for such data concerning artesian flow, if in existence at all, are not readily obtained.

The Lone Star Spring, lying north of the base line, was purchased by the company and developed by running a tunnel 500 ft. in length. This gives a permanent flow of 15 ins., while prior to development the flow was not more than one inch in the dry season.

The original features of the development work of this tract are the tunneling under an apparently dry mesa in the search for water, it standing alone in that regard among the irrigation districts of California. Other tunnels have been built for water in the sides of the mountains and under the rocky beds of streams, with more or less success, but it is believed this is the sole case of tunnels in similar locations being attempted.

The development of the artesian supply by cutting off the pipe in the tunnels at considerable distance below the level of regular flow is not, perhaps, a new idea, but if it has been done on any considerable scale heretofore the professional papers have failed to note it.

The company hopes to resume work this season. Mr. E. T. Wright, M. Am. Soc. C. E., Los Angeles, Cal., has been the engineer of the company from its organization to date.

ELECTRICAL MEASURING INSTRUMENTS.

(Concluded from page 284.)

In the discussion on this paper Prof. Ayrton said he had devoted much attention to the question of material for springs. If steel could not be used, as was often the case for magnetic reasons, the material which had the least sub-permanent set he had found to be, not German silver, as was often supposed, but phosphor-bronze. He had tried platinum, iridium, platinoid and various alloys, but phosphor-bronze gave the best results.

He and his assistant, Mr. Mather, were at work on an electro-static voltmeter which, if successful, would have the great advantage of involving no waste of power. The most expensive voltmeters in working are the hot wire ones. If, as Mr. Swinburne points out, each volt represents interest at 7% on $5 invested, then the well known type of hot-wire voltmeter, which requires 70 watts when reading to 200 volts, wastes the interest on $350 at 7%. The first cost of this instrument is only about $40, but the power it wastes makes it expensive.

Dr. Fleming said that hot-wire voltmeters for measuring high voltages often entailed a further loss in that the potential had to be reduced by a transformer before measurement, and the loss in the transformer might be two or three times as great as the loss in the voltmeter itself. He was in favor of the use of electro-static voltmeters as far as possible.

Mr. Sydney Evershed called attention to the great contrast between ordinary electrical measuring instruments and pressure-gages. Engineers had asked him why instrument-makers could not make the one as strong and as cheaply as the other. They overlooked the fact that, in making a pressure-gage for the boiler, they were dealing with forces of hundreds of pounds. A Bourdon tube in a cheap pressure-gage might easily have a total pressure of 300 lbs. in it, and the torque on the axle would be something considerable—say an inch-pound. In the case of electrical measuring instruments the forces were exceedingly minute. He had recently taken the trouble to measure the torque on the axle of one of his own instruments; it was only of the order of 10 grains at a radius of half an inch; and it would easily be understood that the difficulties of getting rid of friction in dealing with such small forces were very considerable. He thought that sufficiently met the view of those who considered that there was no more difficulty in making a voltmeter than there was in making a pressure-gage.

With regard to meters, the difficulty in making an electric house-meter was solely one of power. They were so accustomed to measure gas and water by meter, and to have practically no restrictions with regard to the power employed, that they were apt to lose sight of the fact that the whole difficulty in measuring electricity was due to the circumstance that they could not afford to lose any volts in the meter while the current was on its way to the house; nor could they waste more than one-tenth of an ampere at most, in a shunt across the mains. There were very few meters in the market which would stand such rough usage as a gas or water-meter. He had occasion, a few months ago, to see a water meter tested, in the case of a disputed account. The meter had been put in a pit, frozen several times, and subjected to most severe treatment, from an electrician's point of view; yet, when tested, it indicated correctly within 2%, and that was after six years' use. He did not think there was any electric meter which would last six months under those conditions; and, until they could get a meter which would last, not six months, but six years, he did not think inventors could claim to have made any great advance toward perfection in electric supply meters.

Mr. Gisbert Kapp said the author had laid great stress on the necessity of supply-meters being absolutely reliable, especially as a meter which was made for 40 to 50 lights was generally worked with a much smaller number—10 to 15—and, having a small current passing through it, the power available for working it was very small. If the meter were of the pendulum type, first introduced by Professors Ayrton and Perry, it might register backward when no current was passing. That had happened in his own case. He had a meter in his office, which, during the last few weeks, while he had not used the light, had actually registered backward; so that the company would have to pay him, instead of his paying them. The inspector had been several times to see it, and had at length set it right. The meter was perfectly set; he had checked the two pendulums for days together, and they swung absolutely in unison; but, after six months, it was found that they had to be re-set. In that respect, a meter of the motor type was far preferable, because it could never go unless the current passed through it. A meter of that kind would never be unfair to the person supplied. It might be unfair to the companies, but it was to their interest to keep meters right. On the whole, therefore, he preferred the motor meter to the pendulum meter. Of course, they all wanted accurate meters, but there were cases in which it was an advantage to have a meter that registered far from the truth. If, for instance, the meter could be made untruthful during the day, charging the units consumed between certain hours at a lower rate, it would still be to the advantage of the company to accept such a reading, because it would induce consumers to use more energy in those hours during which the load coming from the station was now very small. If 15 cts. per K-W hour were charged for motive power, each horse-power if used ten hours a day during the year, amounted of $340; while with a gas-engine, one horse-power could be obtained for $120 to $145 a year. It was hopeless to expect electricity to be used for motive-power purposes on any large scale, or continuously, unless it could be supplied at a price approaching that of gas. Of course, some little additional charge might be made for the great convenience of having an electric-motor instead of a gas-engine.

If the companies could afford to sell the electricity at 6 cts. to 8 cts. per K-W. hour during certain hours, they might make an arrangement by which the meters would be automatically caused to register at a lower rate during certain hours, and then at the full rate allowed by the Board of Trade during lighting hours. In that way they would encourage the use of electricity for motive power, etc., and increase the revenue of the companies without increasing the maximum evening load.

Prof. Elihu Thomson, in discussing the paper by letter, said that one of the chief considerations which led to the development of the motor meter of the Thomson-Houston Electric Co., was, that it was found desirable that the meters should be applicable to both alternating and continuous currents, and they should register the energy consumed rather than the coulombs passing. In the case of the use of alternate currents, where reactive coils were employed for modifying the delivery of energy, the meter should deduct any return of energy due to self-inductive load. Any meter which responded only to the current utterly failed to register returned energy; but, on the other hand, registered energy which had been sent out, and again on its return by self-inductive loads, thus making a double charge for what the customer had not received at all. It might also be added that the drop in the series coil of the motor meter in question was believed to be very small, and that further improvement in this respect was scarcely necessary. When it was remembered that meters were manufactured which responded to as many as 400 or 600 lamps, and were yet sensitive to a single lamp, without a high percentage of error, it would be seen that the instrument had reached a fairly advanced stage of development. Cut-off magnets had also been made for opening the circuit of the fine wire or shunt circuit passing through the armature of the meter; the turning off of the last lamp breaking the fine wire circuit, and the turning on of a single lamp or more remaking this circuit. Were it not desirable to keep down the cost of production of the meter, it would be possible to make the instrument of greater refinement. This was not, however, needed in actual commercial practice. The meter had also been made from the first to act as a coulomb-meter, by the use of electromagnets instead of permanent magnets to affect the damping disk; and in this respect was like the Hummel meter alluded to by the author. It might be added that the Thomson motor meter had been so modified as to be applicable to the case of arc-lamps in series, and to respond to variations in the voltage. In this case, the armature part of the meter received a constant current in shunt to a small resistance in the main line, while the field coils of the meter surrounding this armature were of fine wire in shunt to loops of eight or ten arc lamps, and the registration obtained was in proportion to the difference of potential between the ends of the series of lamps.

Mr. G. P. Roux said that numerous experiments, made by himself, had convinced him that the majority of meters barely started with one-tenth of the total load, and then with an error of at least 10%. One meter alone, to his knowledge, was without that defect. The Brillie meter, with which many experiments had been made, and which he had himself tried for nearly a year, started with certainty at one-thousandth of the total load. The trials that he had made were with a continuous-current meter with 10 amperes at 100 volts. It was guaranteed by the inventor to start with 0.1 ampere, and actually started with 0.01 ampere. Although necessarily inaccurate at that point, there was no real drawback, for one never had to measure such weak currents. At and above 0.1 ampere, it was absolutely accurate up to 12.5 amperes, which was 25% above its range, and it started at 38 volts. Variations of potential and current of one-tenth per cent. were recorded with a high degree of sensibility. The meter belonged to the class of motor meters, its essential part comprising a movement the speed of which was proportional to the strength of the current to be measured. Unlike all other meters of this class, the rotation was effected by a motor, while the measuring apparatus consisted of an electro-dynamometer that regulated the speed of this motor. An experiment had been made in order to ascertain whether variations of temperature could distress the meter. To this end, one had been subjected to a constant temperature of 60° C. for a period of three days, and afterward re-verified, its indications proving undisturbed. With regard to the consumption of energy by the meter for its own work, the consumption of the Brillie meter was exceedingly slight, by reason of the high resistance (10,000 ohms) of the electro-dynamometer coil, which was always in circuit. Indeed, for a station working at 100 volts, there would be a continual expenditure of only 1 watt. The consumption of the motor was proportional to the load, and about 3 watts for the full load—a quantity quite negligible in view of the existence of meters which consumed at the rate of 10 watts. Referring to the speed of meters, it was certain that low speeds were to be preferred, and that 480 revolutions per minute

at a full load were quite allowable. One important defect, which the author had omitted to notice, was the internal friction of these instruments. In motor meters the work of the dynamo, or of the integrating apparatus, did not represent only the work absorbed by the brake, but further, the friction of the instrument. And, although one was struck by the very ingenious devices used to render this friction as slight as possible, it could not be supposed that this friction remained constant. The chief advantage of Mr. Brillie's meter was that the measuring apparatus was quite free from the effects of friction, being entirely independent of the motor.

NEW HOOK-GAGE APPLIANCES.

By Prof. I. P. Church.

The readers of Engineering News may perhaps be interested in a bried description of two hook-gage appliances possessing some novel features, devised and put to use in the Hydraulic Laboratory of the College of Civil Engineering at Cornell University.

Fig. 1 is a vertical projection of the "spirit-level attachment," made of brass and employed to indicate when the surface of water in a weir tank has arrived at the same level as the edge of the sill or lowest point of a weir or notch set in the end of the

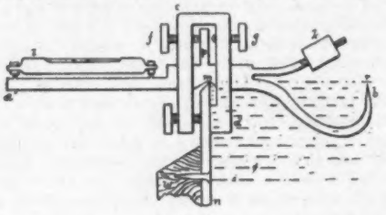


Fig. 1.

tank. It consists of a bar "ab" terminating in a sharp hook at one end and carrying a spirit level "l" at the opposite extremity. This bar is confined loosely in a rectangular frame, or cage, "cd," through which it passes and carries a sharp-edged, V-shaped notch, or depression, "m," on its lower profile. By previous adjustment of an obvious character, the point of the hook is know to be on a level with the vertex of the depression, "m," when the bubble of the spirit-level is centered, the hook being in a vertical plane; "k" is an adjustible counterpoise.

In the use of the appliance the cage is first clamped by screw "e," to the brass plate "mn," forming the edge of the lowest part of the weir or notch,

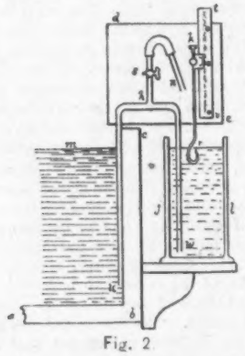


Fig. 2.

and the bar is then allowed to settle until the vertex of the depression is in contact with the edge of the plate. By turning one or both of the screws "f, g," either of which may be brought into contact with the projecting part, "p," of the bar, the latter is tilted until the bubble is brought to the center. The surface of he water being then slowly raised, or lowered, as may be necessary, until its plane contains the point of the hook, that plane must also pass through the edge "m" of the weir plate. (In this drawing, for the sake of clearness, the size of the cage is somewhat exaggerated. The length "a . . . b," is about ten inches).

The hook-gage and scale used for detecting and measuring differences of level of the water surface in the weir tank, and thus determining the "head on the weir" in any experiment, is shown in Fig. 2. It is placed on the side of the weir tank about four feet from the weir. "Abe" is a part of a transverse section of weir tank. The water in the glass jar, "jl," communicates with that in the tank, "m," by means of a glass siphon, of ½-in. bore. When both bodies of water are at rest, that in the weir tank practically so for this purpose, the velocity of approach being small and the face of the tube at "u" being at right angles to the current, their surfaces lie in the same horizontal plane, provided there is no air in the siphon in the line of communication. The jar contains initially sufficient water to cover the end "w" of the siphon, the stop-cock "s" is then opened and suction exerted (by the operator's lungs) through the tube "n;" as soon as the water has risen in the siphon above "h" in tube "hs," the stop-cock is closed. Once "primed" in this way, the siphon remains full of water for days together. In case of any recent change of level at "m," sufficient time, of course, should elapse before the point of the hook is set and the reading taken.

Besides the use of the siphon, the only other novel feature of this arrangement is that not only can the point of the hook be set in the water surface in the usual way, looking from above, and with great precision, since the observer's eye can be brought very close to the jar, but the experimenter can look at the water surface from underneath through the side of the jar (which is of clear glass of even surface, admitting of undistorted view) and bring the point of the hook into the water surface by making it touch its own reflection in the underside (so to speak) of that surface. This would seem to be a more accurate mode of making contact than that ordinarily employed.

UNIVERSAL PROPORTIONAL DIVIDERS.

The ordinary proportional dividers, as all engineers know, are graduated only for certain even fractions, as ½, ¾, etc. Mr. Wm. Cox has designed, and Messrs. Keuffel & Esser, of New York, have for sale a "Universal" proportional divider shown in the accompanying cut (Fig. 1) which makes it possible to set the dividers readily for any ratio desired.

These dividers, for which a patent has been applied, are 10 ins. long from point to point, and are graduated throughout half their length to a scale of 200 equal parts, reading to tenths by means of a vernier which replaces the ordinary slider. The settings are made with a rack and pinion which provides an easy and accurate mode of adjustment, and the fine steel points are movable, being held firmly by screws, so that they can be set to their original length or replaced in case of breakage. They are also made with the usual solid leg.

The theory of the dividers is thus explained: The setting of any proportional dividers depends upon the proposition that when two sides of a triangle are proportional to the two sides of another triangle, each to each, and their included angles are equal, then the third side of the one bears the same proportion to the third side of the other.

If therefore, in Fig. 2, the length of A C is to the length of C D as 5 to 3, then will the opening y be to the opening x, as 5 is to 3. To find the position or setting of C, corresponding to the pivot of the proportional dividers, we have the formula

$$S = \frac{L \times x}{x + y}$$

where L = the total length of the dividers; x = the lesser term of the ratio, corresponding to C D; y = the greater term of the ratio, corresponding to A C; and S = the distance of the pivot C, measured from the end D.

In the instrument we are describing, the whole length A E is supposed to be divided into 200 equal parts, reading with a vernier on the slider to 2,000 parts. If therefore we wish to set the dividers to give the proportion of 5 to 3, we have

$$S = \frac{2000 \times 3}{3 + 5} = 750$$

Therefore by means of the rack adjustment, the slider is set to 750, and the opening x is equal, by any scale of equal parts, to 3 and the opening y equal to 5, as 3 : 5 as 750 : 1,250 and 750 + 1,250 = 2,000. Any other desired simple proportion may be obtained in the same manner.

Settings equivalent to the graduations of the scale of planes are obtained by means of the formula

$$S = \frac{2000 \times \sqrt{x}}{\sqrt{x} + \sqrt{y}}$$

and the settings equivalent to the graduations of the scale of solids of the ordinary proportional dividers are obtained by the following formula:

$$S = \frac{2000 \times \sqrt[3]{x}}{\sqrt[3]{x} + \sqrt[3]{y}}$$

A table accompanies each instrument giving the settings for more than 30 ratios each, for lines,

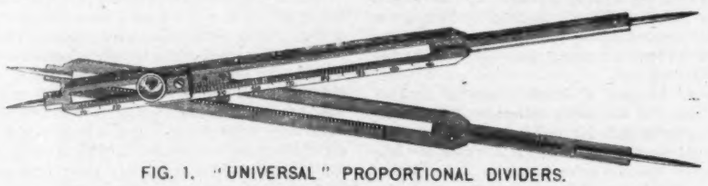


FIG. 1. "UNIVERSAL" PROPORTIONAL DIVIDERS.

planes and solids, besides several miscellaneous proportions.

For example, the setting 483 gives the ratio of the diameter to the circumference of a circle, (1 to 3.1416). It may also be used with a scale of equal parts for finding diameters and circumferences. Setting 939 gives at one end the diameter of a circle and at the other end the side of an equal square. Setting 893 gives the relative values of the diameter of a sphere and the sides of a cube of equal contents. Setting 467 gives the ratio between feet and metres, by means of which the dimensions may be taken from a drawing and converted from one measure to the other. Other settings give the ratio between yards and metres, also between miles and kilometres. Many other settings for similar ratios may be easily obtained by means of the simple formula given, and when calculated put into tabular

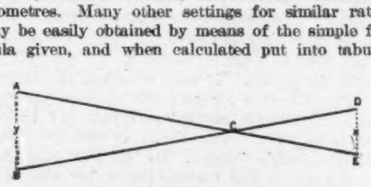


Fig. 2.

form, thus considerably facilitating the graphic solution of practical problems.

From these few particulars, it will be seen that the "Universal" proportional dividers are not only capable of doing anything that can be done with the ordinary style, but that they may be applied to a great many other uses. The setting of the vernier from a table of settings is also quite as easy as the setting of the slider when the instrument is merely graduated for each separate ratio. The instruments are of the very best or "Paragon" make, and are sold, we believe, at $10.

BOILER SCALE AND PURIFICATION OF FEED WATER.*

The amount of mineral matter held in solution by water ordinarily supplied for boiler purposes varies from 10 to 150 grains per gallon, and in some localities even more than this has been found. In some instances water has been used for steam boilers which contained as much as 200 grains per gallon.

It has been stated that as much as 1,300 lbs. of incrustation have been taken from a single boiler at one time. It would seem as though it were almost impossible for so large a quantity of earthy matter to be deposited from waters which average only 17 grains per gallon. When we come to think, however, of the vast quantities of water that pass into a locomotive boiler, in some instances about 45 gallons per mile, we would have, if we accept the above statement, an average of 765 grains, or more than an ounce and a half of earthy matter which enters the boiler per mile; multiply this by 4,500, the average number of miles run by a locomotive per month at the present

*Condensed from a paper by F. A. Stinard, before the New York Railroad Club.

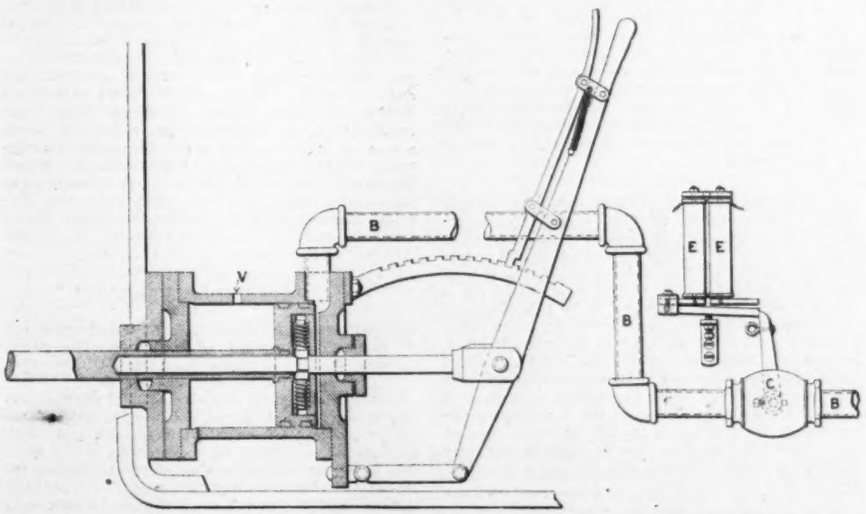
time, we would have a little over 421 lbs. of incrustating matter entering the boiler in one month, or over 5,000 lbs. per year. This amount of solid matter is sufficient to cover 400 sq. ft. of surface ¾ in. thick. Nor is this the maximum; some locomotives take water from water-stations which furnish water that is much below this average in purity.

Scale, whether hard and crystalline, or in soft and slushy deposits, is a very poor conductor of heat, being relatively to iron as 1 to 32, so that 1-32 in. of scale is almost equivalent to an inch of iron interposed between the heat of the fire and the water. Various estimates have been made as to the proportionate loss in fuel from scale. It has been generally accepted that ⅛ in. of scale causes a loss of 28%.; ¼ in., 60%, and ½ in., about 150%, or 2½ times the fuel which would be required if the boiler were clean.

The main ingredients in feed water causing incrustation are carbonate and sulphate of lime and magnesia, and in salt or brackish water chloride of sodium or common salt. The carbonates of lime and magnesia alone do not form a hard scale; in fact, they would not form a scale at all, except when baked on the hard surface of iron by removal of the water, as, for instance, by blowing out a boiler with steam on (something which ought never to be done). If the boiler is allowed to cool, the carbonates will be found in the bottom after settling as soft, slushy mud, of various shades of brownish gray; in this condition they may be easily washed out of the boiler. While the boiler is steaming, the carbonates, which are quite light and of impalpable fineness, are agitated and kept in motion by the currents in the boiler, and are constantly thrown to the surface, until they find a quiet place in the boiler, removed from heat, where they can settle. But when the boiler is allowed to cool down for a while they become precipitated on all the heating surfaces, where the heat bakes them into a more or less hard crust, according to their purity. The sulphates of lime and salt at first act a good deal like the carbonates, as on separation from the water they appear as fine impalpable powders, which are agitated by the currents and thrown to the surface; but, as they are much heavier than the carbonates, they settle more easily, and attach themselves to the heating surfaces as a hard and crystalline white scale, which can be only removed by hand-chipping. In examining scale taken from a boiler it is frequently found that it shows a succession of layers of various degree of color and hardness. In such cases the light-colored, hard layers are sulphate of lime, and the soft, chalky layers are mostly carbonates of lime and magnesia.

The contrivances and methods generally used to prevent incrustation are mud-drums, bottom and surface blow-offs, heating the feed-water, chemical compounds, and filtration or purification of the water before entering the boiler. The mud-drum is in no sense an extractor of either mud or sediment; the position it generally occupies makes it impossible that its contents should ever become sufficiently heated to effect a separation of the salts held in solution. It may collect matter held in suspension, where muddy feed-water is used, but a simple filter would be more effective. The objection to surface blow-offs is that, in order to be effectual, their use must be frequent, thereby wasting water already heated, and at the same time increasing the duties of the engineer and fireman, which leads to a gradual neglect of the means at hand. Feed-water heaters are frequently called "lime-catchers," but the justice of that claim is questionable. In order to effect a complete separation of the salts in solution the water must be heated considerably above the boiling point, and, in addition, time and quiet must be given for precipitation to take place, so that even in heaters which heat feed-water to the boiling point, only a small portion of the lime can be extracted, owing to agitation in the heaters from the currents and the lightness of the carbonates of lime, which need considerable time for precipitation. Feed-water heaters are, no doubt, beneficial, and good results in the saving of fuel are obtained. Chemical compounds act variously according to their composition when put into a boiler. But they in no case extract or remove sediment or deposits from a boiler. The most that can be said of them is that they rot or loosen old scale in the boilers so that it can be easily removed by the hand, or convert the sulphate of lime or other hard incrusting elements into a slushy condition so that they can readily be removed by washing out.

Is this sediment or deposit, when in a soft or slushy state, injurious to the boilers? The larger portion of this slushy deposit is carbonate of lime, which, on account of its lightness, is long held in suspension. When a large amount of water is evaporated in a boiler and very little blowing off is done, the water becomes saturated with the carbonates, which obstruct the free escape of steam-bubbles, and the free action of the heat and the water. This sediment or slushy matter will settle around the seams, and in locomotive boilers around the furnace sides and water-legs, thereby causing leakage at those points and fracture to the side sheets, staybolts and rivets, shortening the life of the flues and necessitating the expenditure of a large amount of money annually for labor and extra fuel. In some localities boilers are washed out two and three times a week, and in some sections of the country the boiler water has to be changed each trip of 150 miles.



THROTTLE-CLOSING AND BRAKE-APPLYING APPARATUS OF THE KINSMAN BLOCK SYSTEM.

In conclusion the author described the feed water purifying system of Mr. Arthur Pennell, which removes the mineral matter from the water while it is in the tank at the water station. The system was described and illustrated in our issue of June 9, 1892.

THE KINSMAN AUTOMATIC BLOCK SYSTEM.

The apparatus illustrated in the accompanying cut belongs to that class of devices which are intended to cause a railway train to stop at a danger signal by automatically closing the throttle and applying the air brakes independently of any action of the engineer. The salient features of the Kinsman system are the closing of the throttle without moving the throttle lever, the use of a fixed "track instrument" of the simplest description, and the location of the "feelers" (which are attached to the locomotive and operate the apparatus when they touch the track instrument) in the flangeway, where they are least liable to injury. Some tests of this apparatus were made on the Fitchburg R. R. about a year ago, and contracts have recently been closed for the equipment of 26 miles of a Western railway with the system. The apparatus will be applied to five locomotives on this road.

The accompanying cut shows that part of the apparatus which is placed in the cab of the locomotive for shutting off steam and applying the brakes. Between the throttle lever and the boiler front is placed a 3-in. cylinder, in which moves a piston which controls the throttle rod. Under ordinary circumstances, the throttle is as much under control of the engineer as the ordinary throttle; and when the steam is shut off automatically through the engine running past a danger signal the throttle lever is not moved. How this is accomplished will be readily seen by reference to the drawing. The throttle rod is telescopic; the piston is made fast to one part and the throttle lever is attached to the other. A spring clutch in the piston causes the whole rod to move together under ordinary circumstances. The engineer can always close his throttle, and (save for a rare moment when the automatic attachment makes amends for his neglect by causing its closure) can always open it. To understand the action of the piston in closing the throttle, reference to other portions of the figure are necessary. B is a pipe connected to the air-brake train-pipe near the engineer's valve and opening at one end into the cylinder controlling the throttle. A cock C in this pipe is normally kept closed, so that part of the pipe to the left of C is open to the air and that to the right has train-pipe pressure upon it. A spring (not shown in the drawing) constantly tends to open this cock, but a catch behind the cock lever prevents it from moving. This catch forms the armature of an electro-magnet E E. When the locomotive passes a danger signal an electric current is automatically passed through the magnet, lifting the armature, and allowing the spring to open the cock C. Instantly the air from the train pipe rushes into the throttle cylinder and drives it to its extreme position on the left. When it reaches this position the throttle is shut and the vent V is open for the escape of air from the train pipe, which applies the brakes. The size of the vent V may be made large or small, according as a service or an emergency application is desired. The throttle lever remains stationary, the jaws of the spring clutch expanding and sliding upon inclined surfaces. An air cushion underneath the piston prevents any concussion at the end of the stroke.

Turning attention next to the means for governing the apparatus above described by the condition of the track, "clear" or "blocked," some form of "track instrument" is an essential feature of all block systems of this class. In the Kinsman system, the apparatus in the track consists of a pair of guard rails of the ordinary pattern used at switches. A system of electric circuits is so connected with these rails that it only needs the closure of the gap between the two to cause a current to pass. Attached to the front truck of the engine is a pair of "feelers." These are designed to travel in the flangeway, and to pass with safety anywhere that the M. C. B. standard wheel-flange will pass. They are hung on springs so that they will not be broken even if an obstacle is struck. A spring on the inside holds them normally with their inner edge in a position about 2 ins. from the flange side of the rail. The guard rails are set slightly closer to the rail than this, so that when the locomotive passes the guard rails the feelers will rub lightly against them, and if the current is on will close the circuit. The feelers are thoroughly insulated, and from them a wire circuit leads to the electro-magnet. The wire is protected from injury by being carried through an iron pipe.

It will be noted that the operation of the system depends on the existence of an electric current in the guard rails, the wire connections leading to them and in the wire circuit leading from the "feelers" on the locomotive to the electro-magnet in the cab, and also depends on the proper operation of the cock in the pipe leading from the brake pipe to the throttle cylinder. At first sight it may seem that this is fatal to the success of the system, since it transgresses the well known principle of railway signaling that derangement of the apparatus should cause the signal to show safety, or in this case should stop the train. But by considering the matter more closely it will be seen that if the system is used only as an auxiliary to the ordinary system of visual signals, the danger from stopping trains needlessly whenever the auxiliary apparatus is out of

order would be far greater than the infinitesinal risk that the engineer and the automatic apparatus will both fail to do their duty at the same time. In other words, a different law and practice on this point should be applied to a primary system of signals and to auxiliaries designed only to act in the rare (yet very important) cases when both engineer and fireman neglect to attend to their duties. We have explained this more fully in our editorial columns in connection with some other problems of interest in connection with automatic block systems of this general class.

Those interested in the Kinsman system claim that it is adapted for use not only as an auxiliary system to visual signals, but as the sole reliance, and without any visual signals. Where it is so used the operation of the air-pipe cock C is caused by the breaking of a circuit instead of by its presence, so that any derangement of the apparatus will stop the train. The system above described is the invention of Mr. Frank E. Kinsman and is being put on the market by the Kinsman Block System Co., 143 Liberty St., New York City.

THE DARLING HARBOR BRIDGE COMPETITION.

We announced in our issue of August 18th the awards to the successful competitors who prepared designs for a bridge across Darling Harbor, at Sydney, New South Wales. An inspection of the conditions of the competition makes evident at once the reason why so few American engineers (only two) thought it worth while to send in designs.

The proposed bridge is to be about 1,100 ft. in length and was required to have a draw-span with a clear opening of 60 ft. on each side. The depth of water at the site is 26 ft. at the deepest part, shoaling to from 10 to 15 ft. near the shore. Borings for a distance showed that the bottom was chiefly clay with occasional thin strata of sand and sandstone. The depth from high water mark to rocks at the deepest point was about 180 ft., this depth extending for a width of about 100 ft. The rock then rose rapidly toward each side of the harbor and was only abutments. The extreme rise and fall of the tide is about 4 ft. Further conditions were stated as follows:

The design must show that it is possible to construct the new bridge without interfering with or interrupting the traffic over the present bridge (a wooden structure close beside the site of the new bridge) at any time. The design must show the practicability of keeping navigation open during the whole time of erection through the old and new structures, as no obstacle in the way of free navigation can be permitted at any time.

The least clear headway over high water mark which it is desirable should be provided for under the center of the spans is 24 ft., with about 26 ft. clear headway under opening span. Clear width of bridge to be 66 ft. between parapets inside. Roadway 42 ft. and two footpaths each 12 ft. clear; but opening span may be reduced to about 38 ft. clear, including footways. Surface of roadway to be formed of wood cubes on concrete. The opening span must be capable of being opened and closed within three minutes.

Bridge to be designed to carry a live load of 130 lbs. per sq. ft. of roadway and footpath, and every part of the roadway is to be capable of carrying a moving load of 30 tons on two pairs of wheels.

The designs are to be shown to scales as follows: General plan and sections to a scale of 40 ft. to 1 in. Details of one plan of each sized opening, with section and cross-section, general drawing of opening span, general drawing of abutments, 4 ft. to 1 in. Details of joints, machinery for opening span, locking gear, etc., 1 in. to 1 ft. The drawings are to be in lines only, in India ink—light tinting to show sections only will be allowed. No colored drawings will be recognised.

A general description of the design, construction, and materials proposed to be used in the work is to be furnished, and also an estimate of the cost of the bridge and approaches, to be in such detail and with approximate quantities and prices as to show how the amount is arrived at.

The drawings, etc., will be placed before a board of advisers consisting of the Engineer-in-Chief for Harbors and Rivers, the Engineer and Commissioner for Roads; one non-official non-competing engineer to be chosen by the Minister for Public Works. The recommendations of the Board will be laid as soon as practicable before the Minister for Public Works, with whom will rest the final awards.

The author of the first approved design will receive a premium of £700, the author of the second £300, and the author of the third £200 (about $3,400, $1,450 and $970). The whole of the drawings relating to the three selected designs receiving premiums are to become the absolute property of the Government. The Government will not be bound to accept, or give a premium for any design, or to employ the author of the first or any other design to prepare working drawings and specifications for the work.

An examination of the above conditions shows at once that the competition was not at all likely to attract many of the leading American bridge engineers. To stand a fair chance of a prize a man must necessarily plan in considerable detail the substructure and superstructure and all the problems connected with the construction of both. In return for this work he stood a certain chance, in competition with engineers of the whole world, of receiving one of the three prizes, the average of which would be about a fair price to a competetent engineer for doing the work. It needs only the slightest knowledge of the mathematics of chances for anyone to appreciate the fact that in the long run engaging in such competitions means doing work for less than it is worth; and it is not at all surprising that so few American bridge designers thought it worth while to compete.

Manchester Canal estimates have brought much financial trouble to that corporation. As an example of the manner in which they grew, the following figures for dredging at various dates were submitted lately to the Manchester City Council.

Estimated cost,	Jan., 1891	$1,500,000
" "	Sept., 1891	1,845,000
" "	Sept., 1892	2,235,000

The original promoters always ignored adverse estimates of the cost of the canal, even when made by engineers of eminence. The estimate of the Liverpool Dock Engineers was about $80,000,000; the original estimate of the canal engineers was about $45,000,000, and it has already cost $65,000,000 with all probability of exceeding the estimate of the Liverpool engineers by about $5,000,000.

A railway line through Labrador has been surveyed by Mr. Alfred Palmer, an English engineer. He reports it as quite practicable, from an engineering standpoint. He would start from Chicoutimi, on the Saguenay, northeast of Quebec, and, passing to the Bay of Islands on the Gulf of St. Lawrence, he would run a line 200 miles along the shore to Port Marham, 60 miles from Belleisle Straits. From this terminus, fast steamers could carry the mail to Liverpool in about 3 days. The length of the new line would be about 650 miles. The objections to its construction are that Port Marham is only open to navigation from 6 to 8 months in the year; and that as far as shortening the sea voyage is concerned, it is only the first 3 days of the voyage that passengers usually object to, and their experiences would be equally bad, whether sailing from New York or Port Marham.

PERSONALS.

Mr. W. D. Harris has been appointed Highway Commissioner of Olneyville, R. I.

Mr. M. C. Shaw, C. E., was run over and killed by a cable car in San Francisco, Cal., recently.

Mr. Dion Geraldine, Superintendent of Construction, World's Columbian Exposition, Chicago, has resigned.

Mr. C. M. Lawler has been appointed Assistant General Manager of the Philadelphia & Reading R. R., with office at Philadelphia, Pa.

Mr. J. H. Barrett has been appointed General Superintendent of the Buffalo, Rochester & Pittsburg Ry., vice Mr. George W. Bartlett, resigned.

Mr. Julio F. Sorsano de Tejada, M. Am. Soc. C. E., was married Sept. 1 to Miss Blanche Downs, daughter of Daniel H. Downs, Esq., of Brooklyn.

Prof. E. A. Fuertes, M. Am. Soc. C. E., and Director of the College of Civil Engineering, Cornell University, is now in Europe on a year's leave of absence owing to ill health.

Mr. John W. Hill, of Cincinnati, O., has been consulted by the city of Decatur, Ill., regarding a scheme for the filtration of the water of the Sangamon River for a domestic supply.

Messrs. Geo. S. Rice and Geo. E. Evans have opened an office at 95 Milk St., Boston, as consulting engineers on drainage for cities, towns and private estates, and for all municipal work.

Mr. W. J. Matthews, Superintendent of Transportation of the Savannah, Americus & Montgomery R. R., has been appointed General Superintendent, with headquarters at Americus, Ga.

Mr. and Mrs. Robert E. Peary and the other members of the Greenland Exploring Expedition and the members of the Relief Expedition were received by the Academy of Natural Sciences of Philadelphia on the evening of Sept. 28.

Mr. Edward M. Boggs, hydraulic engineer, of Redlands, Cal., who for several years has had charge of the extensive works of the Bear Valley Irrigation Co., has been elected to the chair of Irrigation Engineering in the University of Arizona at Tucson.

Messrs. Clemens Herschel and J. J. R. Croes, of New York, have been appointed consulting engineers to the Water Board of Albany, N. Y., in connection with the proposed new water supply from Columbia County. They have already examined the watershed referred to.

Mr. Chas. A. Allen, Am. Soc. C. E., City Engineer, of Worcester, Mass.; Mr. S. M. Gray, Am. Soc. C. E., Providence, R. I.; and Mr. Lucian Taylor, Worcester, Mass, have been retained as experts by the Quincy Water Co., of Quincy, Mass., in the case between the company and the city. Under an act of the legislature the city has taken the works of the company, the value to be decided by a commission.

Mr. W. L. Webb, Assoc. M. Am. Soc. C. E., has resigned his position as instructor in the College of Civil Engineering, Cornell University, to accept a professorship in the University of Pennsylvania. His place will be filled at Cornell by Mr. W. E. Mott, a graduate of the Mass. Inst. of Technology, in 1889, and for one year a teacher at that Institute. Since 1890 he has been engaged in general practice.

Prof. Louis M. Haupt, for 20 years Professor of Civil Engineering in the University of Pennsylvania, has resigned his position, though his resignation will not be acted upon by the Trustees until next October. Prof. E. Otis Kendall, Dean of the Faculty, has expressed, in a letter to Prof. Haupt, the sense of the great loss the University has sustained by his retirement from the chair he has "so long and so worthily filled." Prof. Haupt wishes to devote his whole time to certain state and municipal works, upon which he is engaged. He is a member of the Lake Erie and Ohio Canal Commissions, and for some time has been preparing a project for the Delaware and Raritan, and Delaware and Chesapeake ship canals. Mr. Edward Marburg, late bridge engineer with the Phoenixville Bridge Works, has been elected an Assistant Professor of Civil Engineering at the University.

NEW PUBLICATIONS.

TRANSFORMERS: Their Theory, Construction and Application Simplified, by Caryl D. Haskins, Assoc. Mem. Inst. Elec. Engrs. Lynn, Mass.: Bubier Pub. Co. 12mo, Cloth, pp. 150; 38 cuts. $1.25.

It is probably hardly realized outside of electrical circles how great a revolution has been wrought by the use of the transformer. Until its invention, or more properly its utilization, the transmission of electricity over any great distance was practically impossible; the size of central stations was limited by the low potential current used for incandescent lighting, which made long circuits impossible except at enormous expense for copper. But when the transformer was made a practical success, and the alternating dynamo was invented, it became possible to change the potential of an electric current with small loss and without the use of moving machinery. Thus a high voltage could be generated by water or other convenient power and transmitted for miles with very little loss over small wires. At or near the place of use it could be converted to a low voltage current which involved no danger to life and little to property. The importance of this may be realized from the fact that, although the first commercial transformers were brought out only about six years ago, at the present time, Mr. Haskins says, more light is being distributed by means of transformers than by all the direct current systems combined.

The book in question is well suited to the needs of an engineer who wishes to understand the working of transformers, but has only a moderate knowledge of electrical science; and he will find the author's explanations easy of comprehension.

TRADE PUBLICATIONS.

TRAIN SIGNALING SYSTEM.—Mason Air Brake & Signal Co. Chicago: 8vo, pamph., pp. 16; 8 cuts.

This is a description of a compressed air train signaling system similar to the Westinghouse, and claimed by the manufacturers to be interchangeable with it and also with the New York and Boyden compressed air signals. This does not mean, however, that the valves and other details of the Mason system are identical with the Westinghouse, but that cars equipped with one system will operate successfully in a train equipped

with the other system. We are surprised to find, however, that the company has made the radical error of adopting a standard air pressure for its system of 60 lbs. per sq. in. The standard pressure for the Westinghouse compressed air signal is 25 lbs. per sq. in., and this standard has been formally adopted by the M. C. B. and M. M. associations. Whether there are minor advantages or disadvantages in the higher pressure is of no consequence. Any company offering a compressed air train signal as interchangeable with those already in use must conform to the standard of pressure which the railways have adopted or its apparatus cannot be considered interchangeable.

The Mason Co. claims for its signal that it is more durable and reliable than other compressed air signals. The air supply is taken from the train pipe of the brake system instead of the main reservoir, as in the Westinghouse signal. The advantage claimed is that the maximum pressure is more uniform in the train pipe, hence the rate of flow through the reducing valve is more uniform. An equalizing reservoir has been added, which is placed in connection with the air signal pipe on short trains and has the effect of making the total air volume on long and short trains more nearly equal. The conductor's signal valve is so constructed that when opened it will vent only a certain volume of air no matter how long or how short a time it is held open. The catalogue does not give the prices of the apparatus, a matter concerning which railway officials who still use the old bell rope will be apt to inquire first.

SOCIETY PROCEEDINGS.

ROADMASTERS' ASSOCIATION OF AMERICA.—By a compositor's error the date of the annual convention at Chattanooga was given last week as Oct. 8 instead of Oct. 18, as it should have been.

WESTERN RAILWAY CLUB.—At the meeting on Sept. 20 a paper on "Steam Car Heating" was read by Mr. A. M. Waitt; an abstract is given in another column. The election of officers resulted as follows: President, W. H. Lewis, Chicago, Burlington & Northern; Vice-Presidents, A. M. Waitt, Lake Shore & Mich. Southern; Wm. Forsythe, Chicago, Burlington & Quincy; Treasurer, Allen Cooke, Chicago & Eastern Illinois; Secretary, W. H. Marshall.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.—The twenty-first meeting will be held at Hotel Brunswick, New York City, on Monday, Oct. 10, at 10:30 a. m. The technical work arranged for the meeting includes reports from the standing committee on Roadway, Machinery and Transportation, report from the special committee on Railway Signaling, a paper by the Secretary on "A Method of Draw Bridge Protection," and addresses and discussion on the following topics: 1. Experience in Working under the Standard Code of Train and Telegraph Rules. 2. Methods of Examining and Instructing Railroad Employees. 3. Motive Power. Compound Locomotives. Electric Traction. 4. Progress in adopting M. C. B. Standards. 5. Practical Tests of Railroad Appliances. 6. The World's Columbian Exposition.

C. A. Hammond, Secretary.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Sept. 21, Prof. W. B. Potter read the paper of the evening on "Water Supplies for Large Cities." The paper described the sources of our water supplies and showed the differences in mineral contents as affected by the nature of the rocks which it met in the Eastern cities, where the supply passed over the granite rocks the mineral matter is small, while in the West, where limestones and clay are met with, the amount is large. The different methods of filtering were described and their uses shown. The question of boiler scale was noticed and the preventives considered. After mentioning the evil effects due to the presence of large amounts of lime, the more important organic impurities were fully discussed. The nature and character of the impurities found in the four classes of water supply, rain, surface, ground and deep water, were dwelt on in detail, and a number of tables were exhibited showing the water supplies of the larger cities of the country.

Arthur Thacher, Secy.

NORTHWEST RAILROAD CLUB.—At the meeting on Sept. 13, a paper on Steam Car Heating was read by Mr. J. C. Halladay. Discussing the relative cost of steam and stove heating, he said that experiments made on the Chicago, Burlington & Quincy showed that independent heaters of the Searle, Baker and Westinghouse patterns consumed about 200 lbs. of coal per car per day. Anthracite coal, costing about $6 per ton, was used. Estimating the condensation with steam heating at 50 lbs. water per car per hour, there was computed a saving in the cost of fuel of $12,250 in a single season by the use of steam heat. Mr. Halladay considered, however, that 60 lbs. per car per hour was more nearly correct for the average condensation. Assuming 7 lbs. water evaporated per lb. of coal, this would give a coal consumption of about 8½ lbs. per car per hour. The cost of the fuel used in steam heating can thus be readily computed, if the cost of the locomotive coal is known.

The greatest difficulty experienced in the use of steam heat has been to regulate the temperature in the cars. The hot-water or indirect systems have conquered this difficulty, but the direct steam system still retains its place as the best system for suburban and similar short-trip service.

STREET RAILWAY ASSOCIATION OF NEW YORK.—The tenth annual meeting was held at Saratoga Springs, Sept. 20. Delegates were present from six railway companies. President John N. Beckley, of the Rochester Ry. Co., addressed the members, calling especial attention to the work done by the Association in opposing legislation hostile to street railway interests. We quote as follows:

The most important function of a state street railroad association is to furnish information to the members of the legislature as to the needs of street railroad companies, and to combat before legislative committees and in personal intercourse with senators and assemblymen the erroneous propositions which are often advanced without adequate knowledge of the condition of things. A great majority of the members of our legislature are honest men, who, when informed as to the facts will act intelligently without injury to any legitimate industry or business. There always has been and there always will be others in every legislative body, who take advantage of every opportunity which ingenuity can suggest, to strike corporations by the medium of unjust and hostile legislation. Thus far, the street railroad companies of the state have not been injured by unwise or dishonest legislation. But immunity cannot always be secured, except as the result of diligent and intelligent effort on the part of the street railroad companies themselves. A fair and intelligent presentation of the facts as they exist, made at the proper time, I believe, will always protect the interests with which we are identified; but such presentation ought to be made by the representative of this Association, and such representative ought to stand for every street railroad corporation in the state.

Continuing, he alluded to the gradual overcoming of the prejudice against the trolley system in New York and in Brooklyn. The complete success of the trolley in Brooklyn is now assured, and there is every reason to believe that the old-fashioned, slow moving and nuisance creating horse cars in New York will soon give place on all the lines to the modern systems of propulsion by electricity or cable.

Street railway men are learning that it pays to be liberal in the management of their properties. It is in accordance with good business principles to keep a little in advance of the reasonable demands of the people with reference to improvements, additions and extensions. A good feeling on the part of the people toward the company which serves them adds to the receipts of the line, makes it easier to obtain needed concessions from city governments as well as from individuals, and prevents the granting of franchises on parallel lines to competing companies where, perhaps, only one line can be made a commercial success.

Again, it is advisable from a business standpoint, to establish a transfer system whenever local conditions warrant it. It may seem that railways which now obtain two fares from passengers desiring to go from one part of the city to another by the cars on two lines, would be losers if they carried such passengers for a single fare. The experience of the Rochester Ry. Co., however, has been that its receipts have been materially increased by the transfer system, which was adopted a year ago, after careful study of the question.

On March 1, the Rochester Ry. Co. advanced the wages of the motormen and conductors on electric cars. Their pay had previously been the same as that of drivers and conductors of horse cars. The company found that a higher grade of men was needed for the electric cars; and, as the duties performed were more onerous and exacting, higher wages were considered just. The company has found that, while the item "wages to employees" has increased, the reduction in repairs, and greater freedom from accidents, due to the more careful handling of the cars, have been sufficient to make the net result a saving to the company.

Too much pains cannot be taken to instruct motormen and conductors in the proper handling of the motors and the course to be taken when trouble of any sort occurs. On the Rochester lines, one of the men best posted as to the construction and use of the motor, is made instructor of motormen. He rides with each man a half day or more until the pupil is thoroughly competent to handle the car properly in any emergency.

The report of the Executive Committee called attention to the fact that the consolidation of street railway corporations had considerably reduced the membership, and recommended an increase of the annual dues to $50 for corporations of the first class. The report on "Recent Improvements in Cable Railways," which was to have been presented at this meeting, was deferred for one year, on account of the delay in the completion of the Broadway and Third Avenue lines.

During the past year there has been no strike on any street surface railway in the state; something which had not been before recorded for several years. In the opinion of the new committee, the existence of common interests is now recognized and appreciated by both employer and employed in street railway work.

Mr. Chas. J. Bissell, the counsel of the Association, described his work in defending street railway interests before the legislature. He stated as his experience that the great majority of the members of the Legislature were honest and straightforward, and needed only to have matters presented to them in logical and open manner, to properly appreciate the right side of any question, and vote accordingly. He believed that there was but a very small minority in either house whose votes could be influenced by any other means.

The desirability of bringing the smaller street railway companies into membership in the Association was discussed,, and the supply men were enlisted to secure this end. An auxiliary association was formed among them. W. J. Clark, of the General Electric Co., was chosen President.

The report of Mr. L. H. McIntire, Chief Engineer Union Ry. Co., of New York, was read and discussed. An abstract is given elsewhere. Resolutions were adopted congratulating the Union Co. and New York City on the adoption of the latest and most improved method of street railway traction. The following was also adopted:

Resolved, That this Association earnestly deprecates the opposition manifested against the trolley system in various quarters, as being founded upon neither reason nor fact, and as being contrary to the best interests of any community seeking rapid transit facilities and suburban homes for a growing population..

The election of officers resulted as follows: President, C. Densmore Wyman, New York City; Vice-Presidents, Daniel B. Hasbrouck, New York City; Jas. A. Powers, Glens Falls; Secretary and Treasurer, W. J. Richardson, Brooklyn; Executive Committee, D. F. Lewis, Brooklyn; John N. Beckley, Rochester; John W. McNamara, Albany. The increase of dues to $50 for members of the first class, noted above, was ordered. The next meeting will be held in Rochester, Sept. 19, 1893.

COMING TECHNICAL MEETINGS.

SWEDISH ENGINEERS' CLUB,
Oct. 1. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
Oct. 1. Union Station, St. Paul.
ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 1. 1112 Girard St. Secy., L. F. Rondinella.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 3. Secy., C. L. Annan, City Engrs', office.
WESTERN SOCIETY OF ENGINEERS.
Oct. 5. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 5. Secy., F. Collingwood, 127 East 23d St., New York
ENGINEERS' CLUB OF ST. LOUIS.
Oct. 5. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF MINNEAPOLIS,
Oct. 6. Secy., F. W. Cappelen, 1028 Hennepin Ave.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 6. Secy., C. H. McLeod, Montreal, P. Q.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Oct. 6. Special meeting. Nov. 14 to 18. Annual meeting. Secy., F. R. Hutton, 12 West 31st St., New York.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Oct. 7. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 7. Secy., O. Von Geldern, 712 Market St., San Francisco.
WISCONSIN POLYTECHNIC SOCIETY.
Oct. 9. Secy., M. G. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY,
Oct. 9. Secy., Waterman Stone, Baird Building.
AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.
Oct. 10, Hotel Brunswick, N. Y. City. Secy., C. A. Hammond, Boston.
NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 11. Secy., F. H. Warner, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 11. Secy., Chas. S. Howe, Case School.
DENVER SOCIETY OF ENGINEERS AND ARCHITECTS
Oct. 11. Secy., Geo. H. Angell, 36 Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Oct. 11. Secy., Parker N. Black, Capitol Block.
AMERICAN INSTITUTE OF MINING ENGINEERS,
Oct. 11, 12, 13. Reading Pa. Secy., R. W. Raymond, N. Y.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Oct. 12. Wichita, Kan.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 13. Secy., Edward Mead, Norton Building.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA,
Oct. 13. Secy., R. N. Clark, Pittsburg, Pa.
WESTERN RAILWAY CLUB.
Oct. 18. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 18. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Oct. 14. Secy., D. W. Mocker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 15. Secy., F. D. Jones, Helena.
ROADMASTERS' ASSOCIATION OF AMERICA.
Oct. 18. Chattanooga, Tenn. Oct. 19. Atlanta, Ga. Secy., J. H. K. Burgwin, Grand Rapids, Mich.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 19, 20, 21. Cleveland, O. Secy., Wm. J. Richardson, Brooklyn, N. Y.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 19. Secy., S. E. Tinkham, City Hall.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Oct. 20. Secy., C. F. Franson, 113 Adams St.
NEW YORK RAILROAD CLUB.
Oct. 20. Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Oct. 20. Secy., J. F. Wilson, 24 W. 4th St.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Oct. 21. 201 Washington Building.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21, 22. Roanoke, Va. Secy., J. E. Schick, Roanoke.
NEW ENGLAND RAILROAD CLUB.
Nov. 14. Secy., F. M. Curtis, O. C. R. R., Boston.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 17. At Atlanta, Ga. Secy., F. A. Charpiot, Macon.
CENTRAL RAILWAY CLUB,
Nov. 23. Secy, S. W. Spear, E. Buffalo N. Y., Iron Works.

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AND

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The neat demonstration of the law of flow of water over a wide-topped dam which is contributed by Mr. Jos. P. Frizell to this issue, and which appears to be confirmed by experiment as well as by theory, seems to us somewhat of an accession to hydraulic formulas and deserving of record among them, unless some of our mathematical readers can detect a flaw in it which has escaped our notice. According to it, one-third of the total head of water above the top of the dam goes to give velocity, and the remaining two-thirds to give cross-section, i. e., the thickness of the sheet of water on the outer edge of the dam should be always two-thirds of the total drop from the water surface above to the top of the masonry, the discharge over such a wide-topped dam and a thin weir being in the ratio of 3.09 to 3.33 under otherwise similar conditions. Certainly this is about the difference which we should expect; a slight disadvantage from the wider crest, but no more.

The other paper in this issue by Mr. Frizell relates primarily rather to a question of professional ethics than to technical questions, though some technical questions also are raised in it of no little interest, and treated with vigor and force. It would certainly be improper for us to form or express any opinions upon its subject matter until the other side had been heard. We may say, however, that an advance proof of the article was sent to Mr. Fanning with opportunity to reply in the same issue. He informs us that absence and professional duties have prevented him from availing himself of this offer, but that he will take up the subject at a later day.

The modulus of elasticity of building stones has heretofore been largely a matter of guess-work, or at least has never been very accurately determined for any stone, still less for a considerable number of stones in a strictly comparable way. In fact there had never before been designed an apparatus practically suitable for such delicate work, so far as we now recall, until that of Mr. A. G. Ashcroft, shown in our last issue, had been designed for the tests conducted by Mr. Thos. Hudson Beare, and described by him in a paper which has recently been published in the Proceedings of the Institution of Civil Engineers. For this and other reasons the paper seemed to us one of rather unusual merit and interest, and we think all our readers who have not already done so will be well repaid by reading the very full abstract of the paper which appeared in our last issue, and which was accompanied by all the original engravings. The close correspondence in the behavior of stones and of metals under elastic strains is something which could not have been expected, and which we have never before seen demonstrated. The stones seem to be far more compressible than steel, sandstones being from 15 to 20 times as compressible, and granite about 4 times as compressible, but the modulus seems to be fully as constant for different pressures up to the elastic limit as it is for the metals, and there is a singular parallel also in the effect of overloading. Whether similar results (i. e. a constant modulus) would result from tests of much larger or smaller cubes is still uncertain. It would be well if it could be determined, as a correct knowledge of the elastic properties of stone is for some purposes highly important.

A curious accident illustrating the uncertainties of explosives, occurred last week on the Reading's Poughkeepsie Bridge route, which is worth more than passing notice. The middle car of a ten-car train was loaded with dynamite. It exploded. Why it exploded must forever remain a mystery. The explanation offered in the press dispatches is that the "force of the concussion" caused it to explode; but it is needless to say that no concussion which can occur to cars in transit, short of an actual smash-up, should have any effect on dynamite in transit; and it is quite certain from the known properties of dynamite, moreover, that under ordinary circumstances it would go through a considerable smash-up without explosion, unless some particles of dynamite happened to get between two pieces of metal. In this particular instance the dynamite may have been old or badly made, or some of the glycerine may have leaked out in fluid form and dripped down by the rails. All these things are known to have happened and caused explosion. Be this as it may, five cars of the train and an adjacent barn and trees were blown to pieces by the explosion, which was heard 35 miles away, and a hole 10 ft. deep was blown out of the roadbed beneath the car, and yet, a brakeman who was riding on top of the car itself suffered no who was riding on top of the car itself, if the press reports may be trusted, suffered no injury except a few slight bruises due to being

This instance teaches that laboratory demonstrations of the "entire safety" of substances or processes involving inherent elements of danger are not to be trusted, and yet that the most marvelous escapes are possible from the most terrible dangers.

We chance to note an item that Yale has just lost a "promising student"—for the foot ball team—who was expected to take the place of the mighty Heffelfinger, because "he succumbed to typhoid fever in Chicago a fortnight ago." How does it happen that a young fellow like this, who was not only "cleanly and well fed" (which certain newspapers have discovered to be a sufficient safeguard against cholera) but a real athlete in his prime, is dying of typhoid fever in Chicago? We commend the question to those Chicago engineers who have not yet been convinced by statistics that something is radically wrong there and needs more radical remedy than the proposed drainage canal, which at the best will exist on paper only for some years.

We need hardly say that the irrigation map of our entire irrigated crop area in 1889 reproduced from Census Bulletin No. 23, just issued, in another column, is one of great interest, when it is remembered that there has been great growth since 1889 and that the total area potentially irrigated was then and now much greater than the actual crop area. It shows that the vast area in question is already spotted thick with irrigation works at the more favorable points; in other words, that no considerable part of our area is unimproved where improvement is invited by favorable conditions. From this beginning irrigation works may be expected to expand in all idrections, both in size and number, until the total irrigated area makes some approach to the percentage of improved lands in states having a natural water supply, which latter is always small, often far less than 25%. In the aggregate only about 20% of the area of the United States was in farms in 1880 and less than 10% of it was in crop, the aggregate of 13 leading crops (excluding hay) being 136,299,000 acres. If we call each irrigated area equal to two unirrigated areas, we have now (i. e., we had in 1889) the equivalent of 7,262,000 acres of ordinary land which depends on irrigation for its value. Plainly irrigation is becoming a great interest.

This journal has earnestly advocated the passage of a reasonable interstate commerce law fixing certain early, but not too early, dates after which no locomotive should be allowed to work in interstate commerce unless fitted for automatic train and driver brakes, and fixing somewhat later dates after which no car should be used in such service unless provided with both automatic brakes and automatic M. C. B. couplers. The reason why this should be done is not to hurry or harry that large percentage of our railways which are doing extremely well of their own accord, but rather to protect them in the enjoyment of their investment by forbidding the more dilatory, negligent and unenterprising fraction to prolong the transition state of things which is worse than our first. For the present there are three different kinds of coupling going on in our yards; viz., old with old, new with new and new with old. Granting that no one of these is any more dangerous intrinsically than the first, all are more dangerous than either would if it were the only one, because of the mixture. Coupling cars is like playing on the piano in this, that success in it depends chiefly on a semi-unconscious dexterity acquired by practice only. Suppose a man were forced to play on three different widths of piano keys alternately, how long would the most expert player be able to do respectably on either? Yet intrinsically one is as easy to play on as the other. When we further remember that the proportion of new-with-old couplings, the most objectionable class, tends to increase with the number of new couplers in use, instead of decreasing, until more than half the couplers in use are of the new type, we have the strongest possible reasons why any incorrigible laggards should be driven forward by the whip of the law if they will not move of their own accord, and thus save the large majority of more enterprising companies from being injured by their own well doing.

That these views are essentially sound, and that the lines which are doing something already are by no means disposed to oppose suitable and fair legislation, or at least recognize the futility of doing so, is shown by a paper of more than usual significance and interest read by Mr. E. B. Wall, Superintendent of Motive Power of the Panhandle lines, at a meeting of the Central Association of Railroad Officers a few days since, which is reprinted in full in another column. It admirably summarizes the steps which should be taken to avoid needless expense in complying with the law which is recognized as sure to come. It will be apparent from the contents and tone of the paper that even the promise of such a law is having a good effect, strengthening the good in well doing, and pursuading the laggards that it will be better for them to be laggards no longer.

CHOLERA AS A SANITARY AGENT.

The fear that cholera will gain a foothold in our midst will undoubtedly result in the saving of thousands of lives through the increased attention to sanitary matters throughout the country which it is causing. "Cleaning up" is now the order of the day about household premises and in communities ranging in size and age from Guthrie, Okla., to New York. Special sanitary inspectors throughout the land are prying into all sorts of out of the way places and discovering indescribable nuisances, while the odor of chloride of lime, carbolic acid and other disinfectants is frequently encountered in city and country.

Probably no sanitary principle has ever before been so quickly and widely disseminated as has in the last few months the fact that both cholera and typhoid fever are filth diseases and are contracted and spread by means of impure drinking water more often than in any other way, and no sanitary principle, perhaps, is to-day more important than the one which is being learned so rapidly.

Within the past two or three weeks there have been many moves for water supplies of better quality that seem worthy of special notice, all the more so because most of them are evidently prompted by a panic fear of the cholera, though the conditions are far more likely to cause a high death rate from other diseases than from that. Nevertheless, the fear seems a creditable if tardy awakening because of the actual sewage pollution of most of the water

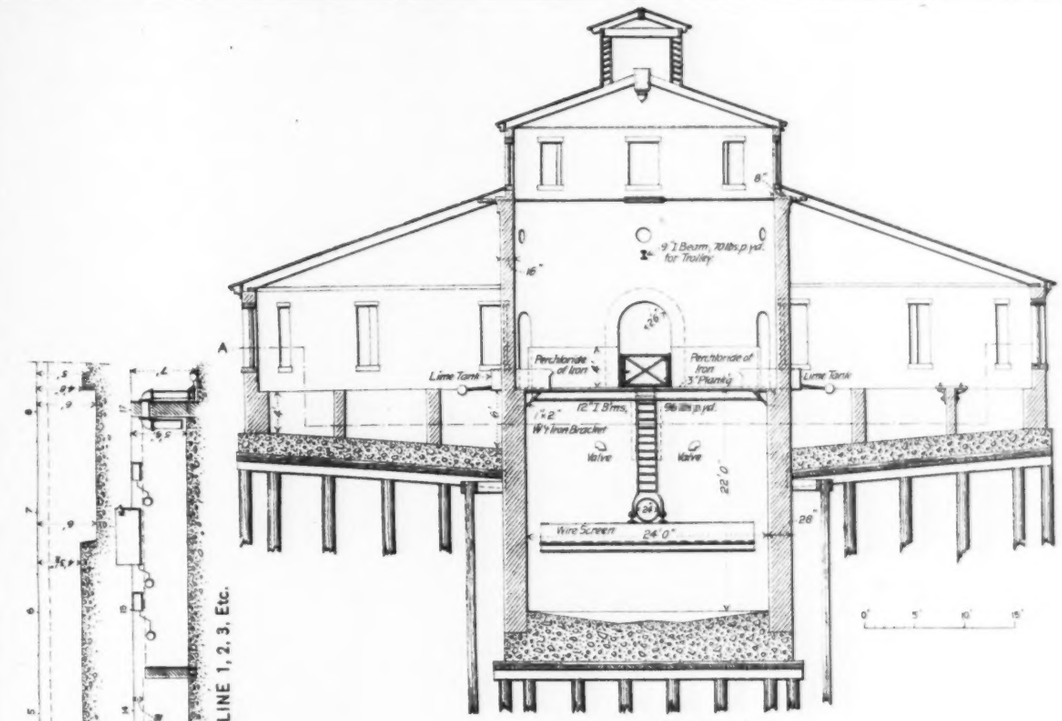


FIG. 26. SECTION C-C.

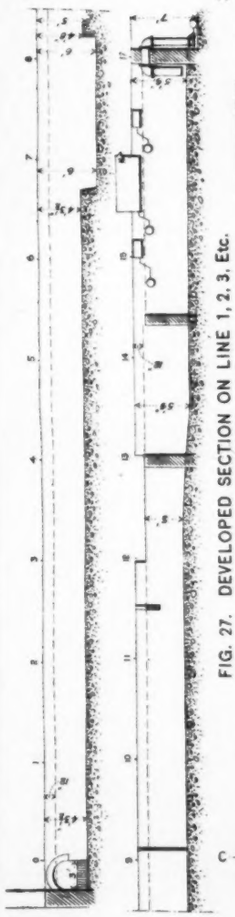


FIG. 27. DEVELOPED SECTION ON LINE 1, 2, 3, Etc.

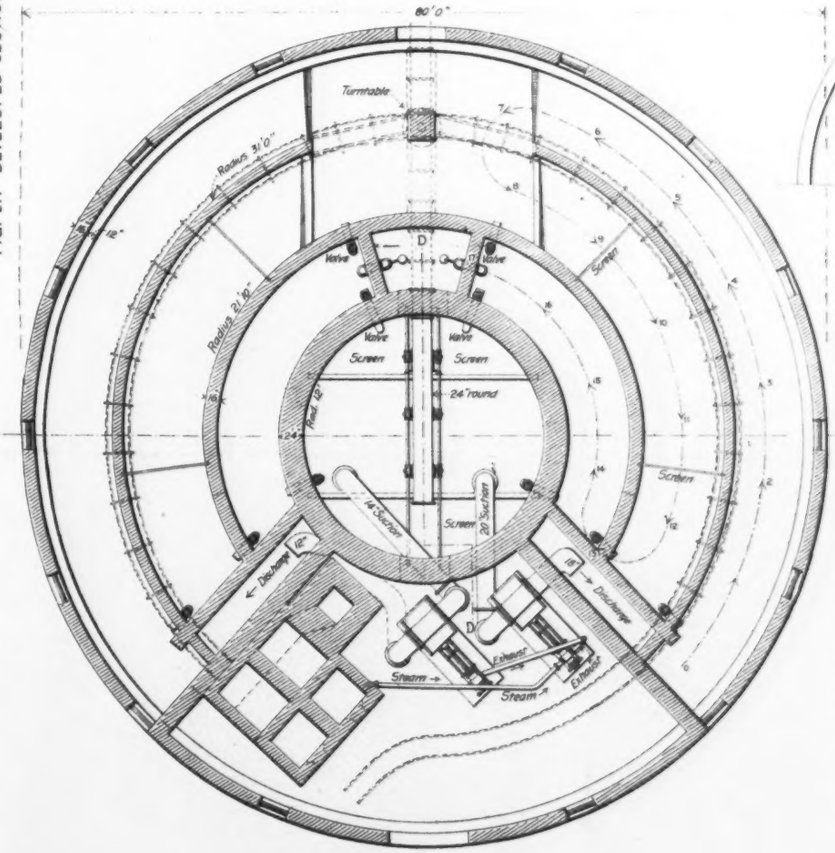


FIG. 25. SECTION A-A.

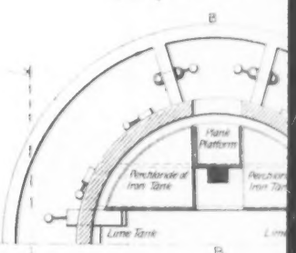


FIG. 28. SECTION

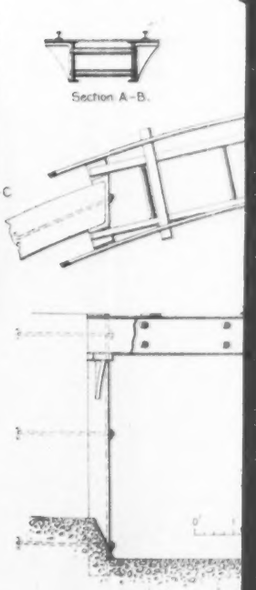


FIG. 30. D

SEWAGE PURIFICAT

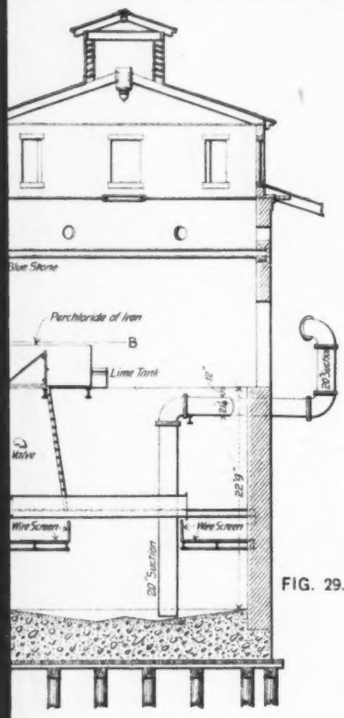
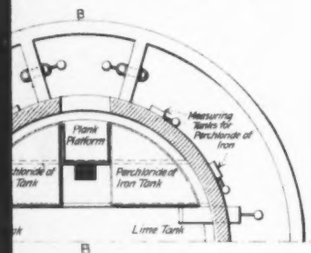
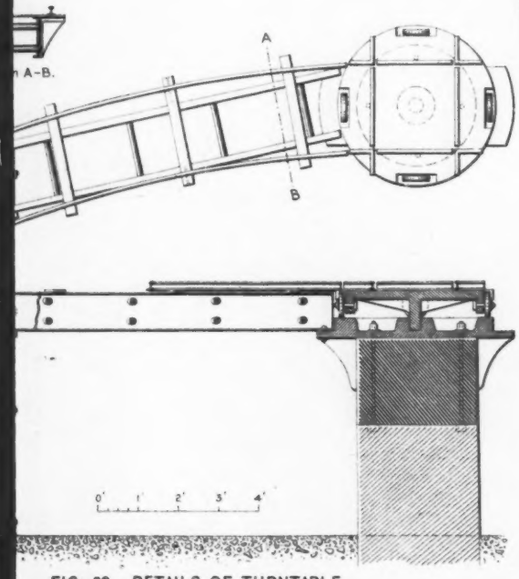


FIG. 29. SECTION D-D.



G. 28. SECTION B-B.



n A-B.

FIG. 30. DETAILS OF TURNTABLE.

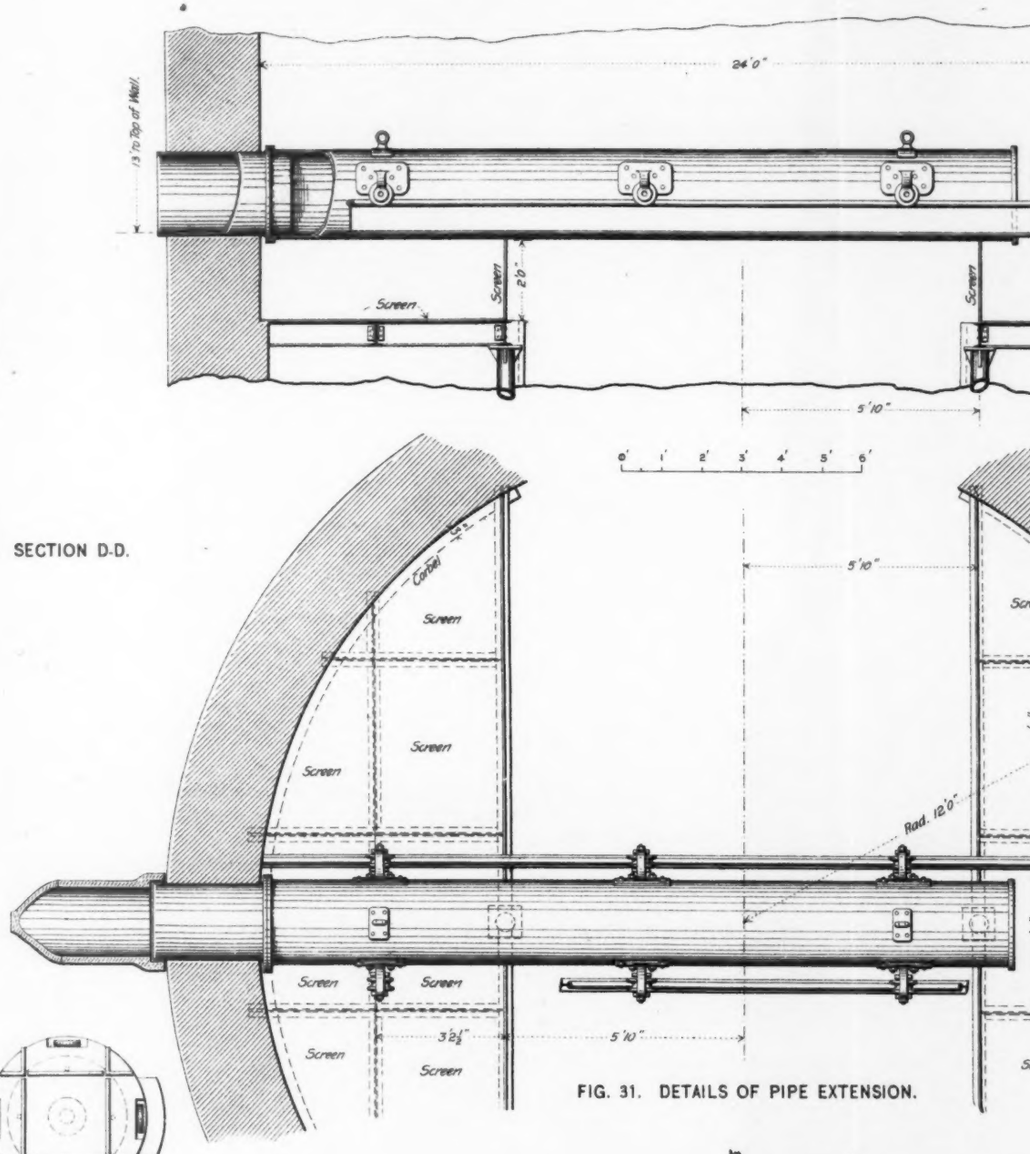


FIG. 31. DETAILS OF PIPE EXTENSION.

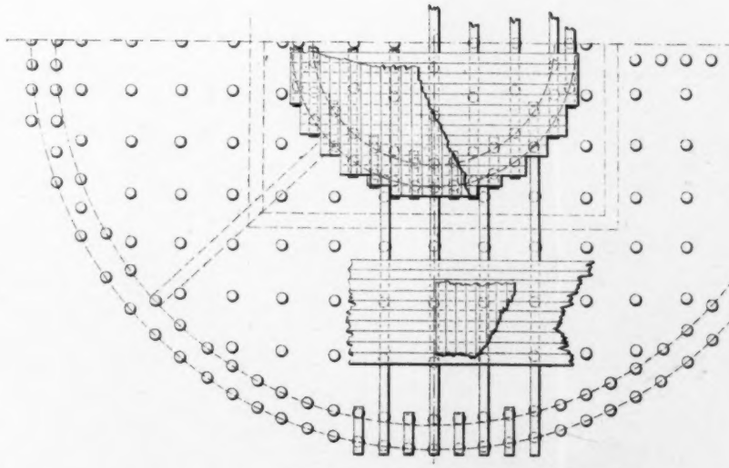
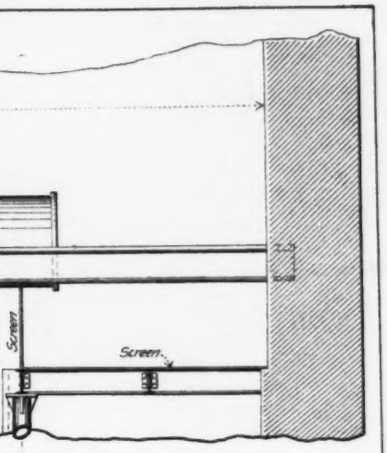
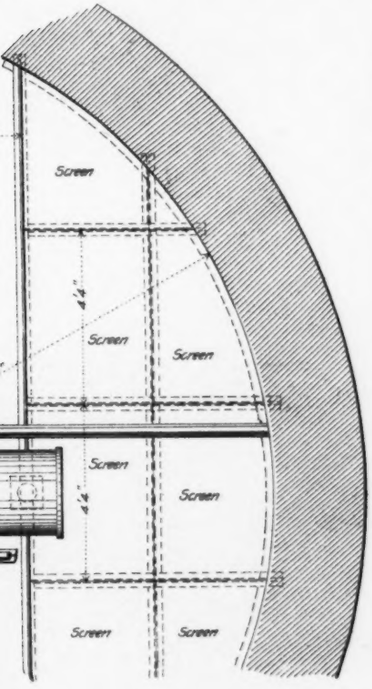


FIG. 24. PLAN OF PILE FOUNDATION.

PURIFICATION PLANT AT SHEEPSHEAD BAY, N. Y.

J. J. Powers, Engineer.





CHAS. HART & SONS, L/TH. 26 VESEY ST., N. Y.

supplies in question, which pollution at a number of cities has already been referred to many times in these columns, and recently in connection with the cholera scare.

Next to Chicago, where the pollution is irregular, and possibly to Philadelphia, where the pollution is more nearly constant but perhaps less in amount, it seems safe to say that no large American city is in greater need of a pure water supply than Jersey City. The "sewage polluted Passaic," which this unfortunate city drinks, is a phrase far too familiar to many; so familiar that it has ceased to produce much impression. Until recently Newark also drank this foul water, but a greatly improved supply has just been introduced (see Eng. News, Aug. 1 and 8, 1892) which makes all the more obvious the deplorable condition of its sister city.

Inspector Thos. C. Leake, who is employed by Jersey City to inspect the Passaic River, recently reported to the Board of Street and Water Commissioners as follows:

I have taken samples of the water and had them analyzed, and the report of the chemist is that they are all very injurious, and the condition of the water is such that if at any time any germs of disease should get in they would live and multiply rapidly, and cause some great epidemic some day. The pollution of the Passaic River is increasing every day, and I do not understand how the people of Jersey City who have to drink this water keep well. I would suggest that all water be boiled before drinking. I would also suggest that you have the chemist of the Board come before you and explain some of the poisonous matters that show in the analysis of the water, and the danger there is in using it in its present state. If Jersey City ever needed anything it is, undoubtedly, a new supply of water.

Agitation for a better supply has been going on more or less earnestly for years and Inspector Leake's report made known nothing new; but only a few days later, Sept. 21, the Street and Water Commissioners unanimously adopted the following resolution without discussion or comment, it is said:

Resolved, That in view of the present impure condition of the water supply of Jersey City, as shown by the report of the Inspector of Pollution filed with the Board, the Committee of the Whole, in conjunction with the Chief Engineer, be directed to prepare specifications for a new supply of pure and wholesome water whereon proposals may be called for.

The kind of water supplied to the people of Allegheny, Pa., is graphically set forth by Dr. Benjamin Lee, Secretary of the Pennsylvania State Board of Health, in a letter received by Mayor Kennedy, of Allegheny, on Sept. 12, as follows:

I am compelled to declare that your water is polluted to an extent which makes it at all times dangerous, receiving as it does the sewerage of about 75,000 of Pittsburg's inhabitants, including that of the West Penn Hospital, in addition to the drainage of the eastern part of your city. The almost stagnant pool from which your water is pumped affords an admirable breeding place for disease germs.

Dr. Lee advised that a new intake pipe be laid to a point further up the river, and three days later, Sept. 15, on the ground that "necessity knows no law," Councils hastily passed in irregular form an ordinance providing that $150,000 be expended for a better water supply. Sept. 21, at a special meeting of the Common Council, a resolution was introduced calling for a $250,000 water loan for a new supply. It was found that the loan could not be legally effected without a vote of the people and the matter was finally postponed.

Providence, R. I., draws its water supply from the Pawtuxet River, which has serious pollutions from house sewage and manufacturing wastes. Official attention has been given the water supply recently and a few days ago the Council passed a resolution call for a joint committee of councilmen and aldermen to

Examine and report at the earliest practicable date what measures and precautions, in addition to those now in use, the city can adopt under the present law, to prevent the introduction of disease germs into its water supply, including the best method of water filtration.

It is to be hoped that the examination will be thorough. There is need of it, though less need than at several other cities.

Throughout the country from the New England to the Pacific States discussions or official action looking to purer water supplies will be found to be going on at a number of points, some of which, besides those mentioned, are the following:

The Manchester, N. H., "Union" and also the "Mirror and American" are just now urging that the city buy and control the land bordering on Lake Massabesic, the source of the city's water supply. Special precautions have been taken recently to prevent the pollution of the water supply of New York city. The necessity of a thorough sanitary supervision of the Croton watershed, with authority to prevent pollution, is greater than ever and we are glad that this truth seems to be appreciated.

At Rochester, N. Y., the Health Board on Sept. 14 passed an ordinance prohibiting the use of well water for drinking or cooking without a permit of the Board. Whether the ordinance will be enforced, however, now that the cholera scare is over for the present, is somewhat doubtful.

The Water Supply Committee of the Pennsylvania State Board of Health has just been examining the water supplies of villages and cities in the Schuylkill River Valley in connection with possible danger from cholera.

At Altoona, Pa., the Board of Health has obtained an analysis of samples of its water supply, and a local paper states in its headlines that the water "is all right if the people will let it settle, and boil and filter it." The water was really found to be in good condition chemically. From its mountainous source we should expect the Altoona water to be rather exceptionally good, for surface water.

The Connellsville, Pa., "Courier" seems to have become "weary in well doing," for it begins a recent article on general sanitation and the water supply as follows:

The Burgess and Town Council seem to be relying on the Lord to protect the town against the evils of a cholera epidemic, though what warrant they have for so doing does not appear.

The town officials, sad to say, seem to be more engaged in quarrels over street paving than in sanitary affairs, but newspaper pressure or a little more cholera scare may yet cause them to see a new light.

At Asheville and Wilmington, N. C., there has been newspaper discussion regarding the relation between drinking water and cholera. At Charleston, S. C., the "News and Courier" of Sept. 15, in discussing the suggestion of a correspondent that "the city should furnish pure drinking water to every household;" which it approves, states that in the previous week there were 22 deaths among the colored and only 4 among the white population. While it is not believed that difference in the quality of drinking water used by each caused this difference a part of the excessive colored mortality is attributed to bad water.

The Health Board of Memphis, Tenn., it is stated, remembering the yellow fever, resolved early this month, to compel the closing of all open wells in the city.

From the entire West little has yet been heard regarding improved water supplies to ward off cholera. Seattle has just had the water supply examined chemically with fair results. Guthrie, Okla., as hinted above, and Salt Lake City have been looking after their general sanitary condition. The West, it should be remembered, is not yet so thickly populated as to be in great danger from sewage polluted water supplies. In addition many supplies are drawn from sources high in the hills or mountains or from artesian wells, and thus are not liable to pollution.

Credit should be given to Chicago for some slight action toward immediate protection of its water supply. Just now some of its city officials are discussing plans for increasing the capacity of the Illinois & Michigan Canal so that more of Chicago's sewage can be kept from the lake where it always threatens the water supply, pending the completion of the main drainage canal which is to cure all evils (?) toward the end of the century.

On the general subject of improved sanitation as a safeguard against cholera Mayor Washburne has but recently introduced some information and advice in a message to the City Council, especially urging that the removal of stable manure be placed under the regulation of the City Health Department. In this connection he closes a most admirable city report, we regret to have to say, with an attempt to make stable manure a scapegoat for Chicago's bad water supply, as follows:

In connection with the sanitary work I would say that too much stress cannot be placed upon the necessity of immediately adopting some method for the removal of stable manure. Expensive and exhaustive researches by Dr. Cyrus Edson, of the New York Health Department, prove that to the presence of rotten stable manure in the alleys is due the greater proportion of cases of typhoid fever and diptheria. In 1891 typhoid fever caused 1,997 deaths in Chicago. Alleged pollution of lake water was blamed for this mortality. There can be no doubt that a large proportion of this death rate, as well as the deaths from diphtheria, can be attributed directly to the heaps of decaying stable refuse which lie in every alley in Chicago.

Thinking there must be some mistake in attributing to Dr. Edson such a startlingly novel contribution as this to our knowledge of typhoid fever, we called his attention to this paragraph with a request for the facts. The subjoined letter, with some matter not pertaining to the subject omitted, forms a fitting end to this review of the increased interest in pure water supplies directly attributable to the educative influences of the danger from cholera which is waiting at our doors and which, if it gained a permanent foothold, might work fearful havoc in many cities through their water supplies. Dr. Edson writes:

Your letter of the 22d inst. has been duly received. If Mayor Washburne has been correctly reported, he has made a very great error, and must have based his mistaken statements upon hearsay reports. No such deductions, relative to the etiology of typhoid fever have ever been made by me. I believe that both diphtheria and typhoid fever are, to a certain extent, influenced by the presence of rotting accumulations of stable manure. Such accumulations will, when primarily infected by the germs of the two diseases in question, hold the infection for a long time, and transmit it to persons who may come into close contact with the infected material. I also believe that emanations from rotting manure may act as predisposing causes to both diseases. But, so far as typhoid fever is concerned, I am firmly of the opinion that over 90 per cent. of the cases contract the disease from drinking water which is infected with the bacillus typhosus.

AUTOMATIC STOPPING DEVICES FOR BLOCK SYSTEMS.

In another column we have described and illustrated an apparatus designed to stop trains at danger points automatically. The working of this apparatus affords an excellent illustration of the fact that blind adherence to a principle will often lead one into serious mistakes. The foundation principle of modern block signaling and interlocking is that any derangement of the apparatus shall cause the signal to go to the danger position; and this principle has come to be very generally understood by railway officers who have any authority concerning signaling work.

The Kinsman system described in another column is not designed in accordance with this principle. Any interruption of the electric circuits or any failure to make the electric contacts at the proper time will prevent the apparatus from doing its work. One naturally forms an unfavorable impression of the system as soon as this fact is perceived; but it is worth while to examine it a little more closely. The system is intended for use in connection with the ordinary system of visual signals, and it is only of use as a safeguard when an engineer, from some cause or other runs past the danger signal, where he should have stopped. Assume that the "percentage of carelessness" among engineers is such that only once in 100,000 times will an engineer run past a danger signal where he should have stopped. Assume also that the "automatic stop," which comes into play when the engineer fails to do his duty, will be out of order once in 1,000 times, when a train passes. Then the chance that both reliances for stopping the train will fail together is 1 in $100{,}000 \times 1{,}000 = 100{,}000{,}000$. It is evident that to cause the train to be stopped whenever an auxiliary signal was out of order would cause much more danger from stopping the train at undesirable times and places than could possibly be caused by the simultaneous failure of the engineer and the automatic apparatus to act. In other words, it is better to have the train run past the danger point once out of every thousand times that the engineer fails to do his duty than to have it stopped needlessly, once for every thousand signals passed.

Of course this applies only to the case where the visual signals are kept in operation and form the main reliance for controlling the train. Where the inventor of any of these automatic stop systems proposes to dispense with the visual signals, and make his devices the sole reliance, he must observe the foundation prin-

ciple above stated or pay the penalty, sooner or later. Some of these automatic stop systems are designed in strict accordance with this system; but others are continually being brought out by inventors great and small, who are more familiar with electricity than with correct signaling practice, which depend solely on the correct working of complicated apparatus to secure safety.

Apart from the question whether they conform to the well established principles of signaling or not, there are many interesting problems in connection with the proposed use of automatic stopping devices. One of the first is, Where shall the automatic stop be placed? Most of the auxiliary devices for use with visual signals have been placed at the home signal, and this is of course the only place for automatic stops of the derailing switch class. Sound signals are also usually placed at the home signal, for if of the torpedo type, their stock of ammunition would require very frequent replenishment if placed at the distant signal. Further, since the engineer always runs past the distant signal, even though it be in a "caution" position, he would grow so accustomed to the sound of the gong that it would not properly warn him.

On the other hand, the home signal means danger, and the danger may be at any point beyond the signal, perhaps only a few rods beyond it, as in the case of the recent collision on the Pennsylvania at Harrisburg. To have the auxiliary to the visual signal do all it ought to do, therefore, it should stop the train before it reaches the home signal.

But with an automatic brake-setting and throttle closing apparatus as an auxiliary to the visual signal, there appears to be no objection to locating the "track instrument" which operates it at the distant signal. The engineer who finds a distant signal at "caution" ought to shut off steam and apply the brakes. If he does not, the automatic apparatus will do it. The train will then be under control by the time the engineer is within sight of the home signal, and as soon as that is moved to safety, he can open the throttle and go ahead.

It may be objected that in tunnels, for example, trains might thus be pulled up and yet the engineer might start up and pull past the home signal, mistaking its indication; but a safeguard can easily be provided against this by providing duplicate "track instruments," one at the distant signal, perhaps 2,000 ft. from the entrance to the block, and the other at some point, say 500 to 800 ft. in front of the home signal.

There is an incidental advantage of no small importance in locating the automatic stop where it will be operated by every train passing, instead of where it would operate only at very long intervals. Experience teaches that devices which are never used except in rare emergencies, are exceedingly apt to be out of order. Even if frequent tests are required by the rules, the matter is apt to be neglected in press of other duties. But where an apparatus is in constant use the fact that it is out of order is at once known.

We have before expressed the opinion that the automatic block signal is destined to greater favor on American railways than the hand operated English block signal system. If one might judge from the efforts of American inventors the future American block system may include an automatic stop of some sort to protect the train at danger points. It is of no small interest to inquire why this addition to block signal practice has appeared in this country, in an embryo stage—and has not, so far as we know, appeared in England. Doubtless one reason is the universal use of the Westinghouse brake in passenger service in this country. In England, where 60% of the passenger cars are fitted with vacuum brakes and 30% with Westinghouse brakes with a good sprinkling of various other braking appliances, an automatic stop system would be difficult of application. Another probable reason is the American tendency toward the use of automatic apparatus everywhere, which has probably had much to do with the main difference between English and American signaling apparatus that is already apparent.

But beyond all these causes it is probable that the chief reason why American inventors have bestirred themselves in this direction is that the public has been several times of late forcibly reminded that perfection in block signals must be made effective by vigilance on the part of engineers. How many inventors set their wits to work on automatic stop systems after the Fourth Avenue tunnel disaster in this city, we do not know; but that accidents of this sort incite many bright minds to devise means for their prevention is beyond question.

It is an unfortunate result of such accidents as that in the Fourth Avenue tunnel, the collision on the Fitchburg two weeks ago, or the recent wreck at New Hamburg, is that they impair the confidence of railway officials and of the public as well in the block system. Why do we have so many serious accidents due to engineers running past danger signals while England has so few? Practically all of Great Britain's passenger traffic is operated under the block system, and while the official accident statistics do not show separately the number of accidents due to the failure to obey signals, perusal of the reports of accidents inquired into by the Board of Trade shows that the few accidents which do occur from this cause are mostly so trivial that in this country they would not be worth a two-line notice in a local paper. To give an idea,—last year 25 of the accidents inquired into were caused by "collisions within fixed signals at stations or sidings." These caused the deaths of one passenger and two employees. Six were due to fog or storm, 3 to excessive speed, 2 to insufficient brake power, and the others to causes with which the engineer apparently had nothing to do.

But observance of signals in this country does not average as high as in England. We cannot shut our eyes to the fact that accident after accident during the past few months or years has been caused by a disregard of plain danger signals, properly displayed. Is this due to the comparatively small use of block signaling in this country, and will it disappear when engineers grow accustomed by life long habit to obey the semaphores? Or is it an American characteristic, due to the undoubted fact that railway employees in this country will not take the semi-military discipline and training, which characterizes European railway service?

It seems reasonable to believe that the first reason is really the correct one.

Where the block system has been introduced in this country it has been and still is, for the most part, used only on short pieces of the most crowded sections of the road. It would not be reasonable to expect an engineer to pay as much attention to a "new-fangled" system under which he runs for only a few miles as he would if all his work were done under it. It is doubtless true, also, that the happy-go-lucky (or unlucky) methods of train movement which have been too much in vogue have injured the engineers' discipline and have been proor education for work under the absolute block system.

But with the extended use of the block system these conditions will be altered. A road which is equipped for its whole length with block signals need not expect a much larger percentage of failures than occur on English roads, at least after a few years.

Notwithstanding these facts it is probably true that collisions which have occurred with the block system have retarded its adoption on American railways. While lack of money has been doubtless the chief reason for the neglect of block signaling in this country, there seems to be more or less sentiment among railway officers that better block systems than those now in use may yet be devised. To those who hold this position the automatic stop systems are certainly worth careful study.

The feature of automatic stop systems which handicaps them most seriously is the fact that they all require the equipment of the locomotive with some form of apparatus more or less complicated. With the ordinary signaling systems the length of road to be protected is what governs the cost and there is no greater expense for a road of heavy traffic than for one of light traffic, if the signals are the same.

It is the roads of heavy traffic which can afford to introduce all improvements on the block system, and they will hesitate long before equipping five hundred or a thousand locomotives with a device of this sort.

Were it not for this drawback the automatic stop system in some form would stand a good chance of universal adoption in place of derailing switches at grade crossings and draw-bridges, and also in tunnels having a heavy traffic. As it is, however, it must stand or fall on its merits for general use, since equipping all the locomotives of a division with apparatus for the sake of one or two dangerous points on it, will hardly meet with favor.

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

We are compelled to postpone for one issue the continuation of our articles on the Engineering Schools of the United States, the next of which will deal with the important question of the distribution of the time of the courses between the several studies.

UNIVERSITY OF ILLINOIS.

Sir: I desire to call your attention to an error in your issue of Sept. 8, page 232, in the matter of the degrees conferred by the University of Illinois. This institution gives B. S. in civil engineering, B. S. in mechanical engineering, etc., on graduation., and gives the degrees of C. E., M. E., etc., only after a year of post-graduate study, or after not less than three years of creditable practice. Yours truly,

Champaign, Ill., Sept. 21, 1892. Ira O. Baker.

THE SHEFFIELD SCIENTIFIC SCHOOL.

Sir: The following, compiled from the annual reports of the Sheffield Scientific School to the General Assembly of Connecticut, shows the number of students taking the degree of Ph. B., in both civil and mechanical engineering studies, and also of those taking the degrees of C. E. and M. E. for the years 1868-1890 inclusive. I have not been able to find any published figures for the years preceding 1868 or for 1891 and 1892. The degree of Ph. B., it will be remembered, is given at the end of the three-years' course, and those of C. E. or M. E. (D. E. (Dynamic Engineer) it is called in some of the reports) after two years of post-graduate study and practice.

	Ph. B. in C. E.	C. E.	Ph. B. in M. E.	M. E.
1868	7	1	1	
1869	11	1		
1870	15	2		
1871	14	1		
1872	9	2		
1873	9	2	10	2
1874	17	2	6	
1875	22	2	9	2
1876	10			
1877	22	2	5	2
1878	7	1	5	
1879	7		5	
1880	7	2	7	1
1881	7		13	
1882	6	3	9	
1883	5		15	
1884	9		15	1
1885	17	2	16	
1886	15	1	17	2
1887	12		16	3
1888	15		14	1
1889	14		25	
1890	18	2	15	1
Total for 23 years	284	26	208	15

In addition to the above there are noted two Ph. B.'s in mining in 1868, three in 1869, and one in 1870. In 1874 there are given two Ph. B.'s in metallurgy. For the years 1869, 1870, 1871 and 1872 the word "engineering" is used without specifying whether civil or mechanical, but I am advised that all graduates in those years were properly civils.

The length of time intervening between the degree of Ph. B. and that of C. E. or E. M. was one year prior to 1873. Since that date it is two years for 11 men, three years for 5 men, four years for 2 men, five years for 4 men, six years for 2 men, eight years for 2 men, ten years for 2 men, while one man required the long time of fourteen years. A Sheffield Graduate.

(The above table shows that just 8% (39 out of 487) graduates of Yale take the post-graduate course. This fact alone shows the absurdity of the claim made by a Yale professor in our issue of Sept. 8, to the effect that the combined graduate course of three years and post-graduate course of 2 years should have been used to gage the quality of the instruction given at Yale, though he made no objection to the use of the graduate (Ph. B.) totals only as a gage of the quantity of instruction.—Ed.)

Rensselaer Polytechnic Institute: We are informed by Director Palmer C. Ricketts, as we expected was the case, that there was "a bull somewhere" in the report furnished us which seemed to show an average of only 7½ hours per week of class work at the R. P. I. The work in fact varies between 2½ and 7 to 8 hours per day, depending on whether it is class work requiring preparatory work or laboratory or field work. We shall be able to include the correct figures in our final tabulation.

MR. FANNING'S REPORT UPON THE DAM AT AUSTIN, TEX.

By Jos. P. Frizell, M. Am. Soc. C. E.

Note.—The great dam to which the following communication refers was fully described in our issue of July 11, 1891, from which we reproduce the accompanying plan and longitudinal and transverse section. Mr. Fanning's report and modified dam section, which the following article discusses, was published in our issue of Aug. 18 last. The dam, as projected, was computed to furnish 14,636 HP. for 60 hours per week, of which about 12,000 HP. was to be available for rental, the rest being used by the city for pumping water, electric lights and street railway service. The horse power at Lawrence, Mass., is about 11,000 HP.; at Lowell, 11,845 HP.; at Manchester, N. H., 12,000 HP.; at Holyoke, 12,260 HP., all during working hours of 60 to 70 hours per week. Lewiston, Me., has about 11,000 HP. These are by far the largest water powers in the country, but the new Niagara Falls tunnel will develop 100,000 HP. potential, and probably utilize 20,000 HP. or more within a few weeks after it is opened.

The fact that the lower level at Austin will be raised about 40 ft. in times of great flood, is admitted on both sides. Mr. Fanning's report, published Aug. 18, says: "During great floods, when there is 15 ft. of water on the crest of the dam, the backwater will reduce the effective head below the dam 40 ft., and the effective fall reduced (without penstocks) to 20 ft."

In his original report, after pointing out the possibility that there might be some future shortage of water), Mr. Frizell proposed a system of flash-boards along the crest to store additional water, in the following words: "A system of flash-boards could readily be applied to hold the water 4 ft. above the crest of the dam, and thus hold a surplus of water in store for such deficiencies, without drawing the water below the crest of the dam This feature will not be necessary for several years, and need not be considered further at present."

The facts will enable the following arguments to be followed more understandingly.—Ed.

The dam across the Colorado River at Austin, Tex., was begun and about two-thirds completed under the direction of the writer in the form shown in the accompanying sketch; the bottom spreading out into a broad toe or apron to shield the vital parts from abrasion, and joining the body of the structure by a curved outline. The question of rounding the crest was fully considered. There were some things to be said in favor of it. The face of the dam would conform more closely to the theoretical trajectory of a stream of falling water, the advantages of which form appear to me to be more fanciful than real. It is a good form of construction apart from any consideration of the direction of the water, well adapted to resist the shocks of floating bodies, especially of ice when that is to be feared. It is a proper and unobjectionable form and, no doubt, advisable when not controlled by other considerations. So much may be said in favor of it.

On the other hand, he who imagines that the rounding of the downstream crest of a dam is of any vital importance has reflected but superficially upon the subject. Were it possible to force the water to leave the foot of the dam in a horizontal direction this in no way destroys its power for mischief. Its velocity is not changed. As soon as it reaches the standing water it assumes a whirling motion, which directs it in full violence against the bed of the stream or against the dam. The water at the Falls of St. Anthony goes down an apron of timber, inclined at about 3 to 1. Holes 50 ft. deep have been excavated by it in the underlying sandstone. The vertical face of the apron, under the issuing stream, was battered to pieces by saw logs and ice; and logs by the score were found lodged under the floor of the apron, having been driven through a wall of timber in a direction contrary to that of the water leaving the apron. I speak here from my own personal knowledge. The timber dam at Holyoke, Mass., when standing with a vertical face was often struck by logs with the force of projectiles. The logs remained fastened in the crib work and, being acted on by the water, became formidable agents of destruction. It is stated that after a heavy flood the downstream face of the dam resembled the wall of a fortress after bombardment. (See Herschel on the Holyoke Dam. Trans. Am. Soc. C. E., 1886). These instances, and hundreds of others familiar to hydraulic engineers, show that the action of water is not confined to the line in which it leaves a dam. It acts with equal force in lateral and reverse directions.

Again, it is only in moderate stages of the stream that the direction of the water can be controlled by any form of construction. A stream of water, falling into standing water or entering it from any direction, does not traverse it to any considerable distance in a solid unbroken stream. The blast pipe in locomotives, the jet pump and inspirator are familiar examples of the fact that a stream of fluid cannot pass through fluid without mingling with it. A stream falling into standing water, spreads, commingles, and expends its energy in eddies, whirls and tumultuous commotions. It is by means of these eddies and commotions that the influence of the stream is transmitted through the water. As soon as any considerable depth of water has accumulated below the dam, the falling water ceases to strike the bottom directly, but acts upon it through commotions and wave movements imparted to the standing water. I say standing water in distinction from falling water, though the former is of course, in violent movement. Under these conditions there is no ground for the statement that the stream would act in a manner more favorable to the stability of the dam, when entering in contact with the downstream face, than at a greater or less distance therefrom. In neither case does it act upon the bottom directly but through eddies and commotions imparted to the water; and the extent, amplitude and violence of these commotions depends wholly upon the mass and velocity of the falling water, not at all upon its direction, or, within possible limits, upon the point where it falls.

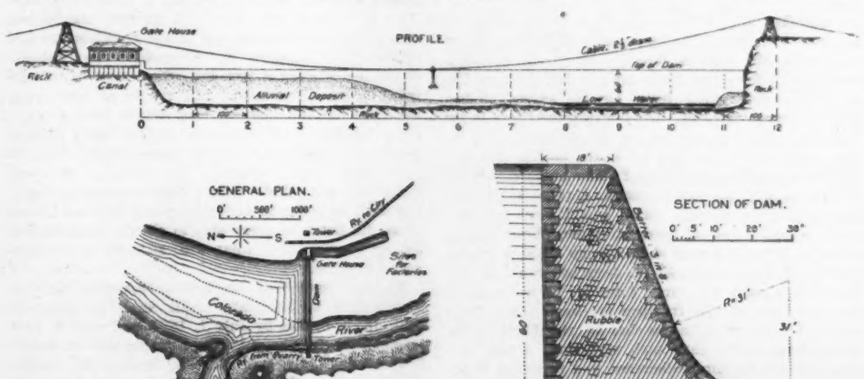
Other reasons had weight. It might be inferred from Mr. Fanning's report that the dam was destined to pass a raging torrent of water month after month: Nothing of the kind. The Colorado at Austin, although draining the immense area of 32,000 sq. miles, carries, according to the best estimate that I can make from over two years' acquaintance with it, an annual volume of water not more than one-fourth that of the Merrimac at Lawrence, Mass.; not more than one-eighth that of the Connecticut at Holyoke. The dam of the Essex Company, at Lawrence, is understood to be 900 ft. long; that of the Holyoke Water Power Co., 1,017 ft. The length of the Austin dam is about 1,150 ft., so that the quantity of water passing the dam per lineal foot of overflow, would not exceed one-third that at Lawrence; one-seventh that at Holyoke. Large quantities of driftwood are brought down in floods, but there is an entire absence of those two potent agents of mischief, ice and saw logs. Simultaneous freshets throughout the whole or a large part of the drainage basin have been known to produce enormous floods; the greatest on record occurring some 27 years ago and attaining for a few hours a height of 45 ft. above low water mark. Only two rises of importance occurred during my acquaintance with the river. In April, 1890, and June, 1891, the water rose very rapidly to a height of 20 or 25 ft., and fell almost as rapidly as it rose. In the latter case it was back to 3 to 4 ft. above low water in 48 hours from the commencement of the rise. A rise of 11 ft. occurred in April, 1891. No other rise of more than 5 or 6 ft. occurred during the time I speak of. Small rises of 3, 4 and 5 ft. are of frequent occurrence. For four days out of every five the flow did not exceed 1,000 cu. ft. per sec. For half the time not over 600 to 700.

A careful study of these conditions led me as engineer to the opinion that, the dam being given abundant strength and solidity to resist any possible static pressure, and provided with a broad spreading toe or apron to shield the vital parts from abrasion, the rounding of the downstream face might safely be dispensed with in favor of more important considerations. It appeared to me that lack of water threatened the success of the enterprise more than a superabundance of water. Thirty days seldom pass without rain in some part of the vast drainage ground appertinent to the dam, causing a rise of a few feet at Austin. If such rises could be held and used according to necessity, a material increase in the quantity of power would result. The lake created by the dam extends over 20 miles with a surface of some 80,000,000 sq. ft., or some 1,836 acres. A depth of 8 ft. on this area would furnish 1,000 HP. for 80 days, or 2,000 HP. for 40 days. Could this volume of water be held and expended every 80 days, it would add 1,000 HP. permanently to the water power. Such an amount of power brought into requisition after the original power was appropriated and exhausted, could not be worth less than $25 per HP. per annum.

The absence of ice and saw logs makes it perfectly practicable to erect and maintain on the top of the masonry dam a system of flash boards, shutters or wickets, to hold eight or ten feet of water above the normal level of the lake; such barrier to be thrown down on the approach of freshets. The entire practicability of such disposition has been demonstrated in recent years, especially at the dams on the Kanawha visited the past summer by a party of the American Society of Civil Engineers. It was not supposed that this arrangement would be immediately required, but it was deemed advisable to leave the dam in a shape to admit of it when called for, that is, with a broad flat surface on the top, leaving details for future consideration.

Another consideration appeared to relieve the work of all solicitude as to the abrasion of the bottom. The bottom consisted generally of a very firm rock, such that a good laborer with stone-pick, wedge and hammer could excavate it at the rate of about ¾ cu. yd. in a day. For a distance of something like 100 yds., streaks of material occurred removable by pick and shovel. Through these the foundation of the toe and upstream face had been carried down to hard rock. From the short duration of floods, no serious damage was to be looked for from a single rise. On its subsidence the flow over the dam could be suspended for days and weeks. The bottom could be inspected, incipient abrasion detected, remedial measures executed. A bed of Portland cement concrete 10 yds. wide, 100 yds. long, 1 yd. deep could be put in for $6,000. There is no probability that such a measure would be called for more than once in five years. The power to hold eight or ten feet of water above the normal level of the lake, a power destroyed by the rounding of the dam, would ultimately be worth to the enterprise $25,000 to $50,000 a year.

On these considerations the engineer feels satisfied that he adopted the correct method. There are no inflexible rules in engineering. The true engineer, studies all the conditions of the problem presented to his consideration and adopts methods suited to that



COLORADO RIVER DAM, AUSTIN, TEX.; J. P. Frizell, Chief Engineer.

(Reproduced from Engineering News, July 11, 1891.)

particular case. The charlatan and mountebank would apply the same invariable rule to all cases.

Let us now examine Mr. Fanning's reasons for advising the change. The diagrams accompanying his report as presented to the board, are not published in full. I have introduced one of them, viz., the one alluded to in the report aforesaid, in these words: "The diagram presented to you shows the form of a 15-ft. depth flood stream passing over the crest, and the method by which it might act destructively upon the dam." This sentence does not appear in the report as published. It must be borne in mind that a depth of 15 ft. on the dam implies a rise of 45 ft. below the dam, which occurred 27 years ago, lasted but a few hours, and was the highest stage ever known. We must also remember that this is a report written by one engineer in criticism of the works of a brother engineer, under the greatest obligation to assert nothing as a scientific fact, one step beyond the limits of his certain and positive knowledge.

The first point to strike the reflecting mind is Mr. Fanning's method of finding the horizontal velocity of the stream. Where did he learn that the mean velocity of a stream issuing from a weir or dam is that due to two-thirds the depth? The same statement appears in other diagrams accompanying his report. It is no inadvertence, no mistake, but a palpable misapprehension of mechanical principles. The assumption is that the initial mean velocity of a fall is that due to two thirds of the depth below the surface, is a mere conjecture. The center of pressure of water on a rectangular vertical plane is at two-thirds the depth below the surface but the total pressure acting theron is that corresponding to one-half the depth, and this is what gives velocity to the stream. The velocity would be that due to one-half the depth in an ideal weir, that is, one in which the crest of the dam has no sensible thickness. In this case we should have

$$v = \sqrt{2g \times 7.5} = 21.96 \text{ ft. per sec.}$$

Other considerations would lead to substantially the same result. By the weir formula devised by Mr. Jas. B. Francis, the discharge, with a depth of 15 ft., should be something like $3.33 \times 15\sqrt{15} = 193$ cu. ft. per second, for each foot in length of the weir. The thickness of a weir stream, at the point where it attains its full horizontal velocity, is about 60 per cent. of the full depth, viz., $0.60 \times 15 = 9.0$ ft. which would give for the velocity $193 \div 9 = 21.4$ ft. per second. The width of the crest of the dam modifies this result, but does not increase it. The velocity with which the water leaves the dam could not exceed 22 ft. per second. There are reasons for supposing that it would be considerably less than this: The path across the crest of the dam is a channel. Water can acquire velocity in a channel only by a descent of the surface. The assumption of 22 ft. velocity at the downstream crest, implies that the surface there is below that in the pond by a height capable of generating a velocity of 22 ft. per second, viz., 7½ ft. This leaves a depth on the downstream crest of 7½ ft. and implies a discharge of $22 \times 7\frac{1}{2} = 165$ cu. ft. per second per lineal foot of the dam.

There is no reason to suppose that the discharge differs so greatly as this from that of an ideal weir, which is 193 cu. ft. per second. A descent of 6 ft. and a depth of 9 ft. on the downstream crest would give a velocity of nearly 20 ft. per second and a discharge of 177 cu. ft. per second. A descent of 5 ft. and a depth of 10 ft. would give a velocity of about 18 ft. per second and a discharge of 180 cu. ft. per second. A less descent and greater depth would diminish the discharge; 18 ft., therefore, is more probably the correct velocity.

Mr. Fanning proceeds on the assumption of a total flow of 200,000 to 250,000 cu. ft. per second in the river; approximately 200 cu. ft. per second per lineal foot of the dam. His assumption of a velocity due to a head of 10 ft. implies a descent of 10 ft. from the surface of the pond to the downstream crest of the dam, and leaves a depth of only 5 ft. at the latter point, giving a discharge of $5 \times 25 = 125$ cu. ft. per sec. per lineal foot, which is $125 \times 1{,}150 = 143{,}750$ cu. ft. per second for the entire dam. He presents a diagram showing the depth of 15 ft. on the downstream crest and a velocity of 25 ft. per sec., implying a discharge of 375 cu. ft. per second per lineal foot, and 431,250 cu. ft. per second for the entire dam. It appears to me that if I attempted to criticise the works of other engineers I would study to make my statements more coherent. We must speak temperately here, however; otherwise we shall have no fitting terms for what follows.

Observe the falling stream descending in a beautiful parabolic curve through 45 ft. of standing water; not only cohering in a solid unbroken stream but actually acquiring velocity as it descends. Observe how the velocities are indicated by figures at different points. Pray, Mr. Fanning, what accelerates this stream of water? Most of us have been taught to believe that the motion of falling bodies is accelerated by the action of gravity. Where the force of gravity is opposed by an equal force of buoyancy, we find it difficult to understand how acceleration can occur. Here again, there is

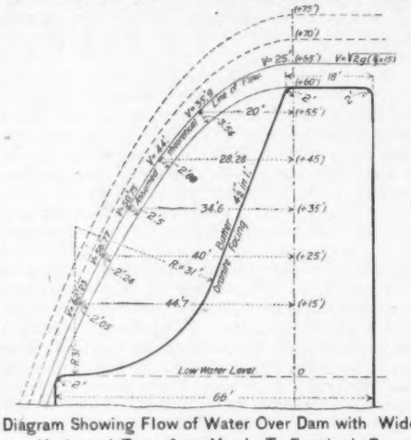


Diagram Showing Flow of Water Over Dam with Wide Horizontal Top; from Mr. J. T. Fanning's Report on Austin Dam.

no mistake, no inadvertence. You really mean to tell your employers that a stream of falling water will strike the bottom through 45 ft. of standing water, with the same force as if it fell through the air! No wonder their fears for the safety of the structure were aroused. Do you imagine there is an Irishman, Mexican, negro or Swede employed on the work who could not be made to see the absurdity of such a proposition? The human body is of very nearly the same specific gravity as water, and in passing through water would meet less resistance than an equal mass of water. Your proposition is: That if a man should jump from a height of 22½ ft. into water 45 ft. deep he would strike the bottom with the same force as if he jumped from a height of 67½ ft. upon the bare rock! Any negro who can swim knows that he would not strike the bottom at all. Into such monstrous errors are men betrayed by blind adherence to a formula. Such reports bring contempt upon the engineering profession and destroy confidence in scientific reasoning.

The stream does not traverse the standing water in the manner shown in Mr. Fanning's diagram, nor in any manner bearing likeness, similitude or analogy thereto. The stream reaches the lower level in a manner analogous to that represented, though the amplitude of the leap is exaggerated by the error referred to, and by another cause to be mentioned. No velocity can exist greater than that due the fall from the upper to the lower level.

No mathematician of the century could attempt with any confidence to delineate the path taken by the water after reaching the lower level. It loses in the course of a few feet its character of a distinct stream, and becomes part of a boiling, seething, tumultuous cauldron of waters, revolving, eddying, whirling, in a manner to defy calculation. Enormous waves roll up from below the dam and tumble into the vortex of the descending cascade, adding their inertia to the retarding forces. Of the nature of the movements arising in the basin below the dam, engineers know, in a general way, this: Their extent, amplitude and violence depend upon the depth of water in the basin below the dam and the amount of energy expended upon that water; that is, upon the velocity and mass of the descending stream. Of course the point where the stream enters the standing water is the center of the most active disturbance and the activity diminishes as you recede from that point in any direction, but whether that point is 1 ft. or 50 ft. from the face of the dam can have no sensible influence upon the oscillatory and gyratory movements through which the water acts upon the bottom. When the stand of water both above and below the dam lowers, these two movements being always coincident, the falling stream draws closer to the face of the dam. When the depth has diminished to an extent that would warrant any apprehension of the direct shock of the stream being transmitted through it, the latter falls far within the line of the toe. When, for instance, there is a depth of 6 ft. on the dam, corresponding to a depth of, say, 20 ft. in the basin below, the water passing the downstream crest would have an initial velocity not exceeding

$$\sqrt{2g \times 3} = 13.89 \text{ ft. per second.}$$

It would descend to the lower level in

$$\sqrt{\frac{2 \times 43.}{g}}$$

=1,635 seconds. Its horizontal movement, in that time, would be $13.89 \times 1{,}635 = 22.71$ ft. It would strike the lower level at a distance of $66 - 22.7 - 16 = 27.3$ ft. inside the line of the toe. Another cause would operate to draw the stream still closer to the face of the dam. The boundaries of the channel rise above the dam on both sides. The air would be excluded and a tendency to vacuum under the sheet would exist.

A POLICY FOR THE APPLICATION OF AIR-BRAKES AND AUTOMATIC COUPLERS.

By Edward B. Wall.*

Congress did not pass a law at the session just concluded on the application of air-brakes and automatic couplers, although the House of Representatives passed the O'Neill Bill, which would have become a law if the Senate had agreed to it and had not had a bill of its own. If the session had been a little more protracted it is very probable that an agreement would have been reached between the two bodies and we would have had a compulsory law. The indications are, from the interest engendered, that a law will be enacted at the next session and it therefore behooves us to consider the probable character of such a law and what steps we should take in the construction and repair of our equipment, to the end that we may not at least do anything which will increase rather than diminish the cost of adding new appliances to our cars and engines. We might as well make up our minds that there is going to be a law and, with this in view, we would be blind indeed if we did not take every step to alleviate the burden on our companies of what will, at best, be an enormous expense.

The bill passed in the House stipulates that all locomotives in interstate traffic shall be equipped with driver brakes by July 1, 1895, and that no new locomotives shall be put in such traffic without driver brakes after July 1, 1893. The Senate Bill simply provides that all locomotives shall be equipped by Jan. 1, 1895.

On automatic brakes for cars, the House Bill requires that all cars shall be equipped by July 1, 1898—six years—and that no new cars or cars which have received general repairs since the passage of the act shall be hauled without such brakes after July 1, 1895—three years. The Senate Bill modifies this greatly. It stipulates that by Jan. 1, 1895, there shall be a sufficient number of cars in a train equipped with automatic brakes to enable the train to be controlled without hand brakes and says nothing about the further equipment of the cars.

On couplers, the House Bill enacts that all cars shall be equipped by July 1, 1898—six years—and that no new cars which have received general repairs since the passage of the act shall be hauled without automatic couplers after July 1, 1895—three years. These provisions are the same as those for air-brakes. The Senate Bill places the limit for the equipment of all cars at Jan. 1, 1898—five and a half years.

It will thus be seen that when a law is passed, we will probably be given from 2½ to 3 years in which to equip locomotives with driver brakes; from 5½ to 6 years to equip cars with couplers; 6 years in the House Bill to equip all cars with air brakes and 5½ years in the Senate Bill to equip about one-third

* Supt. M. P., S. W. system of Penna. R. R. lines west of Pittsburg, and President Columbus Division of the Central Association of Railroad Officers, before which the paper was read, Sept. 22.

of the cars. I estimate one-third, as this is a safe estimate of the number which experience has shown would be required to meet the conditions stipulated by the Senate.

In order that this burden may be spread over as long a period as possible and that we may not have to undo what we are to-day doing, it is essential that we should adopt a policy which will cover the following:

1. All new locomotives shall be provided with driver brakes. It would be well, where the company is able, to further issue instructions that driver brakes shall be placed on all locomotives receiving general repairs. The close agreement between the Senate and House on a very short allowance of time to accomplish this work points to the fact that we will be greatly hurried if we do not begin now. It may be said for this expenditure that there are few other investments on a railway that will bring such immediate beneficial returns.

2. All cars built henceforth should be equipped with air brakes. I recognize that the treasury of some companies will not permit this, however wise the expenditure, and that it will be necessary for them to wait until a special loan is raised for the purpose; but no matter how poor the road, they will be the victims of the most short-sighted economy if they do not adopt a brake rigging on all new cars that will operate with the air brake.

It has now become generally understood that the air brake cannot be made to perform its functions with the old brake rigging in use on cars provided simply with hand brakes. The Master Car Builders' Association has, happily, solved this part of the problem for us. They adopted a brake rigging in 1889 that has successfully met the requirements of service and is now universally adopted, whenever air brakes are used on freight cars. If we place this rigging on our cars, we will simply have to add the equipment furnished by the air brake companies to have them fully equipped with automatic brakes; otherwise, we will have left on our hands a brake rigging that will be worth scrap, less the labor of taking it down and putting up the new rigging.

3. All cars built in future should be equipped with automatic couplers. Where companies cannot afford this, as in the case of air brakes, they should adopt a draft rigging that will receive the automatic coupler by simply removing the old draw-bar and tail pin and putting in the new coupler with its tail pin.

4. In repairing cars, all old draft rigging removed should be replaced with new draft rigging designed to receive the automatic couplers. This should even be done on very old cars—cars that have, say, but two years left of their life, because the rigging will then, in most cases, be available for use in repairs. This application of a new draft rigging on repairs is of great importance. We have on hand, on most railways, sufficient material to maintain the running repairs on our old draft rigging between now and the period when we will be compelled to equip exclusively with automatic couplers. It is on cars and in stock. It is the part of wisdom to stop manufacturing any more irons for this purpose and to put on new rigging at such a rate as will maintain the general repairs, using the old irons removed and in stock for running repairs on the old style rigging. This may necessitate, occasionally, the bringing in of cars to the shop to remove the old draft rigging, but even then it is to the advantage of the company, as it all tends to reduce the enormous pile of scrap which will be left on hand when the period of grace granted by the law has expired. If we do our duty, that pile will be largely worn out irons and scrap "de facto" and not simply scrap "de jure."

5. The application of couplers to cars now in service should be at a rate, irrespective of any probable law of Congress, equal to the consumption of the present draw-bar. This condition would entail on many railways an expense that they could not at present bear, but for those who can meet the condition, it would be greatly to their advantage.

The 5½ to 6 years that Congress proposes to grant represents a little more than the life of the present draw-bar, which I estimate at from four to five years. It must be recognized that such an estimate is only tentative, on account of the present very large admixture in service of automatic couplers and the constantly increasing number of consolidation engines and heavy cars, together with due consideration for the difference in kinds of metals used and in the designs of draw-bars. If we were, consequently, to stop buying new link and pin draw-bars and restrict our purchases to automatic couplers, depending upon a supply of old draw-bars for running repairs from those removed in service, we would, at the expiration of the legal period, have no second-hand draw-bars to throw into the scrap pile, and we would have enjoyed the benefit of all our investment in link and pin draw-bars. This course would secure a gradual and natural conversion of draw-bars into automatic couplers. The cost would distribute itself in a normal way and there would be less of a radical and paralyzing hump in the expenses.

6. All automatic couplers purchased should be subject to the proposed tests of the Master Car Builders' Association, which stipulate that couplers shall meet a certain drop and tensile test. This secures good and safe malleable iron, cast steel and wrought iron. The M. C. B. type of automatic couplers has now reached such a stage of development that thoroughly good couplers can be purchased from several manufacturers. The prices asked are not excessive and they are in very close conformity. Therefore, there no longer exists such a great dissimilarity in prices as to lead some railways, hard pressed for money, to purchase inferior goods. The M. C. B. coupler has become a regular article of commerce. It is so simple a matter to devise a slightly different form from any now in service that it can never become a monopoly. As a consequence, the trade of any one manufacturer depends upon the quality of his goods and the price at which he is willing to sell them. If we hold him up to the M. C. B. tests, the quality will not decline to the danger line. The general prices now charged are certain to be reduced to the simple basis of a manufacturer's profit. After the coupler has been longer in use, there will be no necessity for the liberal guarantees now given by some of the coupler companies. These guarantees are now, of course, provided for in the price. Prices will also be reduced by competition, which will compel coupler companies to manufacture their own couplers. At present many of the companies are charged two profits: one on the device and the other on the manufacture, as they farm out all their orders to independent foundries, which must have their profit. In addition to this, competition will produce further improvements in the detail operation of the devices.

7. All automatic brakes should conform to the standards of efficiency proposed by the Master Car Builders' Association. A number of air-brake companies are now preparing to put new systems and new devices on the market, and every railway company, for its own protection and to secure interchangeability in operation and maintenance with other railways, should stipulate, before introducing a new brake, that it shall meet the standard requirements not only in effect, but in fact, as determined by a test on a rack and also on a train.

It is not our purpose here to criticise the two bills before Congress or to point out how they might be changed in order to accomplish the end desired with a minimum of hardship to the railways. A large majority of the railways are in favor of automatic brakes and couplers. This is proven by what they have done and are doing. They believe in them for the safety they bring to their employes and the improvement they afford in transportation. What they have done has been almost entirely of their own volition, and, if left to themselves, most of the railways would add the brake and coupler appliances as fast as their revenue warranted.

Both branches of Congress have very wisely proposed to reach a settlement of certain points in their bills through the American Railway Association, and it is to be hoped that when they enact a law, they will also make that Association the vehicle through which the vote is taken on a standard coupler, or, if they do not, that the Association will cast the vote of the railways included in its organization. This will simplify the matter greatly for the Interstate Commerce Commission and will enable the railways to act with a uniformity and decision that would be otherwise impossible.

We can leave to the strong and able Committee on Safety Appliances of that Association the question of uniform action after the law is passed, but we must decide now, each road for itself, what policy it will pursue in applying air brakes and automatic couplers to the cars it is now building and repairing.

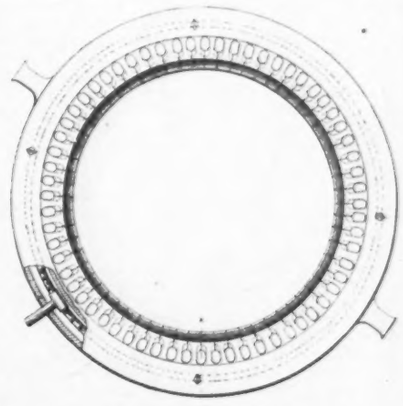
Columbus, Sept. 21, 1892.

A CONTRACTING CHILL COOLED BY COMPRESSED AIR.

The contracting chill for casting car wheels has now come into very extensive use, as shown by a committee report at the last Master Car Builders' convention (Eng. News, June 16, 1892), although many prominent wheel makers and master mechanics still dispute that any advantage is gained by it proportionate to its cost. The theory of the contracting chill is, briefly stated, as follows: When molten iron is poured into a car-wheel mold its circumference in contact with the cold iron of the chill instantly solidifies and begins to contract; but the iron of the chill at once begins to expand because of the heat, and as its diameter increases it draws away from the tread of the wheel. The interior of the wheel is, however, still in a molten state and the heat from it is conducted to the tread, heating it again nearly to the melting point and neutralizing the effect of the chill.

The contracting chill is a chill so arranged that it does not expand when the hot metal is poured against it. In the Whitney chill reliance is placed on the slow conduction of heat to the outer ring of metal of the chill. In the Barr chill, a greater degree of contraction is aimed at by the alternate use of steam and cold water in the hollow interior of the chill. The steam is applied before casting the wheel to expand the chill and make the "initial diameter" of the wheel cast in it as large as possible. As soon as the wheel is poured, cold water is circulated through the chill to absorb the heat and prevent the chill from expanding.

Of course there are some objections to this use of steam and water. It is claimed that the foundry



Contracting Chill for Casting Car Wheels.

is made damp and sloppy, and that the pipes distributing the steam and water are more or less in the way. It is to overcome the first of these difficulties, probably, as well as to "get around" the patents held by Mr. Barr on contracting chills that the device illustrated in the accompanying drawing has been designed. The chill used is similar to other contracting chills, but the inventor proposes to cool it by expanding compressed air in its hollow interior. He also proposes to heat it before use by passing carbureted air into the interior and burning it, a process somewhat attractive in theory but possibly dangerous in practice. In comparing the action of compressed air and water in cooling the chill the inventor says:

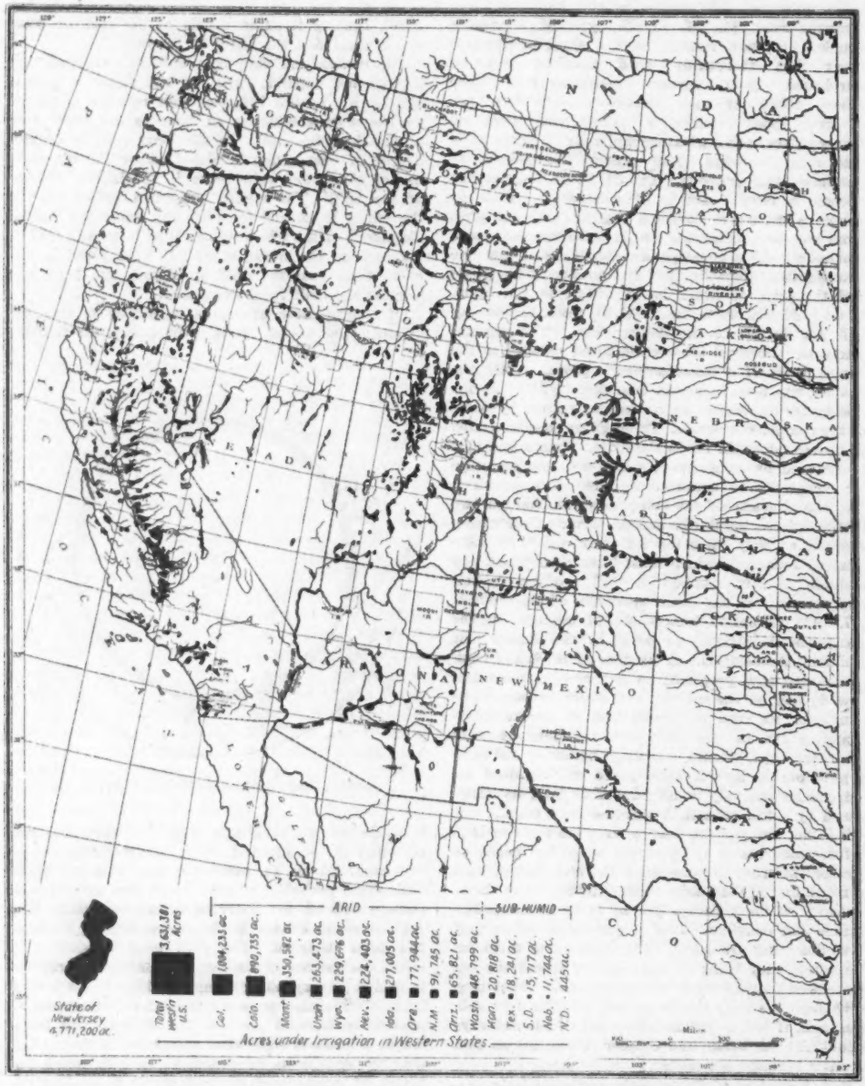
> Heretofore it has been the practice to cool the chills by forcing water around and through the same; but such does not prove to be successful for the reason that certain portions of the chill will become cold before the remaining portions would receive the same temperature. By the employment of compressed air for this purpose the entire chill is cooled at an instant, and thereby produces better results.

Considering the far greater rapidity with which heat is taken up from a metal surface by water than by air, there may be some doubt about "the entire chill being cooled at an instant." However, the compressed air would doubtless be used at a much lower temperature than the water, so satisfactory results might perhaps be attained. As the patent (No. 481,442) is assigned to the C. A. Treat Mfg. Co., of Hannibal, Mo., we may perhaps have wheels made by this process on the market at an early date.

IRRIGATION IN THE WESTERN UNITED STATES.

The location and extent of the irrigated areas of the United States which yielded crops in 1889 is shown by the accompanying map, taken from Extra Census Bulletin No. 23, prepared by Mr. F. H. Newell.

The actual irrigated area in each state is shown by the squares at the bottom of the map, as are also the relative areas irrigated in each state. The total area irrigated in 1889 was 3,631,381 acres, or 5,674 square miles, which is about 0.4% of the total land area west of the 100th meridian. About 65% of the irrigated area was devoted to the raising of various kinds of forage. The aggregate number of irrigated agricultural holdings in 1889 was 54,136.



MAP OF WESTERN STATES, SHOWING LOCATION AND AREA OF IRRIGATED LANDS.

It is interesting to note how irrigation follows the large rivers and their tributaries, as the Missouri and Yellowstone, the Snake, Platte and Arkansas and the San Francisco and San Joaquin Rivers. The Colorado River, flowing almost its whole length in a deep canyon, of course has no irrigated valleys except its headwaters and the headwaters of its tributaries.

Nevada, which needs water badly enough but has poor laws, is backward and has but a small amount of irrigated land. The Eastern states, all in the area under consideration, the Dakotas, Nebraska, Kansas and Texas, have but recently begun to irrigate, being located in the subhumid regions where irrigation is more a safeguard against years of drouth than an actual necessity for the raising of crops.

CAR HEATING BY STEAM.

A paper on this subject was read at the last meeting of the Western Railway Club, by Mr. A. M. Waitt, Asst. Master Car Builder of the Lake Shore & Michigan Southern. Stating at the outset the settled fact that for some years to come steam is destined to be the working medium for car heating the author described the direct and indirect systems and argued that the direct system was the best for coaches and the indirect system was best for sleepers. We quote as follows:

On the railroad with which the writer is connected we have had in use in coaches both systems of heating, and with the indirect have tried four different kinds. We have had weekly, and sometimes daily, complaints of freezing traps, lack of circulation, cold cars, burst pipes, etc., while from the direct system, generally only one complaint has been heard, that of occasionally too much heat in mild weather. The result of the above experience, after three or four years repetition, has been to cause the adoption by the Lake Shore & Michigan Southern R. R. of the direct system for all coaches, baggage and mail cars. On sleepers the experiment has been tried with both systems of heating, resulting in the almost immediate abandonment of the direct system; for when the berths were made up for the night and circulation of air was arrested behind the curtains, the heat became too oppressive for sleeping; and the porters were too apt to neglect the regulation of the heat, if, indeed, it were possible to properly regulate it. This result, of course, left the indirect system alone in the field for this class of cars. As there were many indirect systems proposed and used, it became a study to see which was the best, and to remedy, as far as possible, all existing defects.

It must be said of the writer's experience with indirect steam in sleepers on the rear end of from 12 to 14-car trains, that in zero weather the complaints of cold cars, with temperature not above 60°, were very numerous, and this with a pressure from the locomotive of 80 lbs. It has also been found in such cars in zero weather, that with cars cool when leaving a division terminal, and from 2 to 10 lbs. of steam on the gage, it would taken from 1 to 3 hours before a temperature of 70° was reached, and in many cases but little rise in temperature was obtained even in that time.

Taking up separately the different parts of steam heating apparatus Mr. Waitt said that for the train pipe the general practice was to use 1½-in. pipe well covered with asbestos lagging. He saw no advantages in carrying the train pipe overhead as practiced on a few roads. For connections a flexible wire-bound rubber connection is cheaper and freer from leakage than any flexible metallic connection. A well made rubber hose, five-ply, wire bound, made of not pure rubber, will stand at least one season's service without failure, and such hose are now made and guaranteed for such a time. It can also be said truthfully that there are in the market steam couplers, free from leaking, simple in manipulation, and highly satisfactory, that have now successfully stood the test for years.

Inside the car the method of controlling the steam by a single three-way valve near the middle of the car is preferable to two single valves on each side of the branch pipe or two cocks in the train pipe at each end of the car under the platform. The three-way valve is simpler to understand and manipulate, is less work to apply, and is less liable to collect condensation and freeze. The cocks under the platform are objectionable because the cocks can only be opened or closed when the car is standing still. The three-way valve should have the water from the drip pass in contact with it to prevent the drip from freezing. We quote further as follows:

When the use of direct steam for car heating was first adopted, there was a fear of insufficient heating and a mistake was made by the use of altogether too much radiating pipe. One of the first plans consisted of two lengths of 2-in. pipe on each side of the cars, and in addition a spur of 2-in. pipe from 12 to 30 ins. long under each seat. This resulted in putting steam heating into bad repute by making cars perfect sweat boxes, and making it very uncomfortable to sit on the cushions with a hot steam pipe directly under the entire length of each one. Gradually the use of spurs and return bends have been curtailed, until now the most approved arrangement consists of two lines of 2-in. pipe on each side of the car, without any spurs or radiators under the seat. In some cases it has been deemed best to use 1½-in. pipe, and in addition a short 10-in. spur under alternate seats.

With the indirect system of heating, experience has shown that there has been a lack of the requisite radiating surface, and it is being gradually increased. The prevailing practice has been to use 1¼-in. pipe, and the same amount of it as with the simple Baker heater. In the writer's opinion much better results would be obtained in long cars by using not less than 1½-in. pipe, thereby allowing freer circulation and increasing considerably the radiating surface.

The radiating pipes on each side of the car in the direct system should for proper regulation of heat and adjustment, have a separate steam controlling valve, and a drip valve, also a separate pressure gage.

Steam Admission Valves.—In this feature of steam heating lies much of the secret of successful results in the direct system of car heating. Most cars at present are equipped with an ordinary cheap globe valve to control the admission of steam to the radiating pipes. With such valves in good order, if the valve is just started from its seat by a small fraction of a turn of the spindle, there is an opening made for the steam admission as large, if not larger, than the supply opening from the locomotive boiler. This admission of steam is enough to keep the car well heated in freezing weather, after it has once been warmed up. If the weather is mild, and only enough heat wanted to take the chill off the air, it is impossible to graduate the valve sufficiently fine, but an approximate result must be obtained by alternate turning on and shutting off the steam, which, of course, results in great dissatisfaction.

Another difficulty with the common globe valve for an admission valve arises from the fact that it can be kept in order but a short time. After a few months' use they become so warped that few of them can be closed absolutely tight, and many times it becomes impossible to cool the cars off, except by shutting steam out of the car at the three-way valve. To overcome these difficulties, and to put it within the power of a reasonably intelligent trainman to regulate the amount of admission of steam to the amount passing through an aperture of 1-100 in. in diameter if desired, a committee was some months ago appointed by the heads of

the mechanical departments of some of the Vanderbilt lines, to prepare specifications for a suitable valve. The result has been that two reputable companies are now prepared to furnish at a reasonable figure a valve having all parts subject to wear renewable at small cost, leaving the shell of the valve intact; the valve is capable of an adjustment such that one full revolution of the spindle will give an area of opening of only about 1-100th in., the valve being capable of opening to full area of a 1-in. pipe. The valves are so constructed as to be especially free from cutting out by wire drawing of steam. With a durable valve of this kind it becomes possible for a trainman to be able to readily regulate the admission of steam to so small an amount that it will not even heat the entire length of pipe in the car, and with properly instructed trainmen good results can be obtained.

Traps.—If the inspectors and trainmen on our roads are carefully questioned, it will be found that traps are a source of constant trouble, sometimes from freezing up or choking with water, and sometimes from allowing too much steam to waste. Of all the traps examined by the writer, after they have been in practical operation for any great length of time, none have been found but what need constant readjustment to suit any material changes of outside temperature. It often happens that on starting on a long run, a trap may be all right for the present temperature, but after a 400 or 500-mile run the theremometer stands 20 or 30 degrees lower; under these circumstances, many traps become choked with water and frozen, causing delays for thawing out and readjusting.

In view of these facts, many companies have abandoned the use of traps, and have substituted a much more satisfactory method of caring for the condensation, namely, the use of a globe valve at the end of the radiating pipes on each side of the cars. In some cases it has been deemed wise to file a small groove in the valve seat, so that it can never be entirely closed. Such a groove is intended to be large enough to take care of all condensation in mild weather, and in cold weather the trainmen are expected to adjust the opening of the drip valve to suit the amount of condensation. By others it has been thought best to leave the drip valve intact, and to allow trainmen to regulate it for all conditions. This arrangement permits of allowing the condensation in mild weather to partially fill the radiating pipes, and the heat can be then controlled by the amount of condensation allowed to pass off. It can be readily seen that by this arrangement if half the pipes were filled with water, the steam would only reach and heat the other half of the pipes.

With the present state of invention in relation to traps, I think the plain drip valves have decided advantages. In this connection I would recommend that where possible, the steam admission and drip pipes should be kept in contact, and covered in the same jacket, and the outlet of the drip be in contact with the three-way valve, or pass through it as is arranged for in one style of three-way valve now on the market.

It may be of interest to know that since last spring a committee representing several of the Vanderbilt roads have had in hand an investigation of the matter of steam heating for cars, and a summary of the results of their work is contained in the following recommendations for adoption:

1. That the "direct" system of steam heating be used for heating coaches.

2. That the "indirect" system of steam heating be used in sleeping cars.

3. That in the "indirect" system, salt water or a non-freezing mixture be used in the circulating pipes.

4. That a three-way valve be uniformly used for controlling the steam in the main train pipe, the parts located inside the car to be uniform, the valve to take a solid (male) wrench, and the marking on the floor plate to be uniform, and to indicate the direction of the main train pipe, and the branch supply pipe, and to be similar in size and style to the Martin floor plates, now in general use on the roads represented.

5. That we approve and adopt for general use the style of steam controlling valves as designed and made for our committee, by Fairbanks & Co., of Boston, and by the Safety Car Heating & Lighting Co., of New York.

6. That the use of traps for taking care of the drip be dispensed with.

7. That we use a globe valve for the drip valve, with a small slot filed in the seat of the valve, so it can never be entirely shut off.

8. That two lengths of 2-in. pipe on each side of the car with no spurs under the seats are sufficient for satisfactory heating.

9. That for "indirect" heating, all pipes and connections, except train pipe, shall be maintained inside the car. That the system be limited to one steam valve and one drip valve, placed uniformly in all cars.

10. That at all terminal and junction points, where passenger trains are made up, or cars are likely to be set off, facilities be provided for heating cars by steam, when not in trains. This, we consider very essential to the successful heating of cars by steam.

RECENT IMPROVEMENTS IN ELECTRIC TRACTION.

Electric systems as first constructed were built on altogether too light a plan, and the increasing tendency is for heavier and more solid construction in every department, but particularly in the way of track and station equipment.

The storage battery has made but little progress during the past year, and is not likely to cut much of a figure in electric traction until it is able to make a better showing, financially, than it has in the past.

The general tendency of the times to consolidate all common interests under one management is showing its effects in electric traction more than ever, and scarcely a week passes that we do not hear of some syndicate obtaining control of some horse road, and the information usually ends with the statement that "it is intended to equip all the lines with electricity." From many points of view this is an improvement and a marked one.

Track.—The early forms of track construction were too light and soon went to pieces; but during the past year heavier rails have been rolled and better joint plates made, so that it is possible to keep the roadbed in perfect line and surface. This improvement has been a great help to the electric equipment and has reduced the cost of maintenance. As the cost of laying tracks is about the same, whether light or heavy, it is economy to put in only the best.

My experience and observation has convinced me that the deep girder rail, about 9 ins. high, spiked directly to the ties, is the best form for paved streets; and in dirt or macadam streets, a 6-in. girder rail laid in the same manner. In the country and where the local authorities are willing, I would lay a T rail, spiked directly to the ties.

The weakest place in all forms of track construction is at the joint. Every manufacturer of rails and many of the railroad companies have tried to overcome this trouble. There are probably as many patents upon rail joints as upon car couplers, and most of them about as impracticable. Up to the present time there has been nothing brought out which surpasses a properly designed fish plate.

While speaking of track construction, it might be well to call attention to the bonding of rails for the return circuit. Many forms have been used, and some of them are still in operation. I believe that a No. 0 copper bond wire long enough to connect with the web of the rail on each end of the fish plate is the best plan. Then ground the whole system at frequent intervals, and abandon the supplementary wire which it has been the custom to use with the common form of bonding.

Electric Equipment.—Probably the greatest advance in any particular line has been in the matter of armatures for motors and dynamos. I consider that the introduction of the "iron clad" type will do more toward reducing the bill for repairs in that direction than any other one thing that has been introduced during the year. The electric companies have all, I believe, now adopted this form as their standard, and all roads that have tried them will, I think, agree with me that for simplicity, ease of repair and ability to stand the hard usage they receive, they stand at the head.

In the manner of controlling the motors most of the companies still use the time-honored rheostat; although I believe one company is endeavoring to introduce a new type of controller, which they will, doubtless, be happy to explain at a later date.

Many roads, acting under misapprehension of the requirements, started off with motors too small for the work, and endless trouble has been the result. Some new classification should be adopted by the electrical companies for designating the power of their motors, as the present "office classification" does not afford a proper understanding of their capacity, and the "horse-power" term is but little better, depending on so many limiting conditions. A more satisfactory way would be to specify the number of pounds the motor can pull at different speeds, with the maximum current for which it is designed.

Trucks.—The first car trucks employed in electrical work were of the pedestal form; that is, the trucks were fastened to the car body and oscillated with the car. The motors, of course, had to be suspended from the car body, and the result was that the grinding of the gears was transmitted through the whole car; also, the oscillation of the car body caused the motors to correspondingly rise and fall. This was very undesirable, and it was soon found necessary to adopt the post form, in which the truck was complete in itself and the motors were supported directly on the frame of the truck. The body was connected with the truck only by springs, thus being entirely free from the jolts and pounding of the truck.

In this form slight spiral springs were first used, the same as in the previous styles, but it was soon found that the high speed attained caused the body to oscillate to such a degree that it became very objectionable, and the different builders then modified their trucks by extending the side bars beyond the axle boxes a sufficient distance to allow an auxiliary spring to be added at each end. For this auxiliary support, coil and elliptical springs have been used, both forms with marked success, and it is now possible to carry a car body 28 ft. over all, practically without oscillation. This last modification has been a very great improvement, and has settled the long car question on most street railways. I mean by this that but very few double truck cars will be used, though, of course, there are places where two trucks can be used to advantage, and in such places they will still be employed. But where we are able to carry nearly as many people on four wheels as on eight, and to apply the power equally on each axle, so that there is no possibility of lack of traction, there can be no gain to the railroad company in using eight wheels.

Cars.—The car bodies first employed were of the same style and proportions as those used for horse roads, and were not properly designed for electrical purposes; first, the framing of the roof was too weak and would not support the trolley board properly; secondly, the framing of the floor was not adapted for the use to which the cars were put; for not only was the framing too weak, but it also was not well planned for putting in the trap doors which are required in order to inspect the machinery underneath the floor.

The car which it seems to me is best adapted for the present service, is one 18 ft. 6 ins. long inside, with platforms 3 ft. 6 ins. long. The rafters should be strengthened with steel plates, and the framing throughout should be heavy.

Overhead Construction.—There has been a general improvement in all parts of the overhead material. We are using stiffer poles, stronger span wires, better trolley wire insulators and handsomer curve fittings; so that the general appearance of the system is much better. The quality of insulation now in general use is far superior to what we had two years ago, and as double insulation is now employed on the span wires very little trouble from leakage is experienced.

The method of feeding the line is a very important matter and should receive careful attention. The best arrangement is to divide the system into several sections, so that in case of trouble along any portion of the line, such as fire, etc., that section can be cut out and the balance of the system run as usual.

The Power Station.—This may be rightly called the heart of the electric system. The chief element to be considered should be reliability, and, after that, economy. A very marked improvement is observable lately. The designers of stations are learning wisdom from their past experiences, and the makers of apparatus are more alive to the requirements of the system, and better material and workmanship can be had where required.

The recent introduction of large multipolar dynamos has brought about a change in station arrangements not heretofore obtainable, and in all large stations now being built countershafting is dispensed with entirely, and the general tendency is toward reduction of parts, which, in turn, means simplicity. It is very probable that we have reached now a form of station that will be fairly permanent, and the main point in the future will be the size of the units. For medium-size stations, engines with releasing valve gear belted direct to a multipolar dynamo will be the best where price of land is not excessive, and direct coupled engines and dynamos for larger stations. To my knowledge there have been no comparative tests made as to the economy of the various types of stations, although all reasoning would point to these latest types as being by far the most economical.

Discussion.

Mr. McNamara, (Albany Ry. Co.): Mr. McIntire failed to tell us if anybody has tried the deep girder rail which he refers to, and found it any better than the system which he recommended to us a year ago. We are using the ordinary tram rail; and I still hope we are right and he is wrong. As to the large generators, it is very comforting to know that you have got a machine that is capable of delivering a large amount of power; but if it breaks down, what then? Your large unit is taken out of service, and unless you have a correspondingly large unit to take its place, you are left without power. It is a question for us whether it is desirable to increase the size of the units, and, if so, what should be the limit. Of course, I take it that the limit is only reached when you are enabled to duplicate the unit; because no one would attempt to operate a railroad, electric or otherwise, unless he were able to operate it continuously; so that if one of your large units fails, you must have another to take its place. In Albany we have worked very successfully with small generators.

Mr. McIntire: The form of girder rail I refer to is laid on 15 miles of road, in the northern part of New York City. It weighs 70 lbs. per yd., and is laid upon yellow pine stringers, 5 x 5 ins. The rails are spiked directly to the stringer, which rests upon cross-ties.

* Condensed from a paper read by Mr. L. H. McIntire before the New York Street Railway Association.

I use a joint-plate, 26 ins. long, bolted with 6 bolts. I put a tie directly under the rail joint, and one under the stringer joint; the balance of the ties are spaced 36 ins., c. to c. I also use an additional tie, 3 ft. long, under each end of the fish-plate, so that the rail joint is supported by three ties. Every tie is tamped perfectly. That gives us a direct supported joint. If it should come down, we have the suspended joint by means of the support from the ties at the end of the fish-plate.

Mr. Lewis: Do you advocate an absolutely tight joint?

Mr. McIntire: Yes; in paving. There is nothing else that you can put there that will stand; you can use any kind of joint; and it will go down if the joint is open and the wheels are allowed to pound. The rail men will immediately inquire, what will you do if expansion takes place? Now, if you lay a center bearing or tram rail in this manner, you get into trouble because it is exposed to the sun and expansion will take place; but with a deep girder rail down in the earth the heat is radiated, and you do not have that trouble.

In answer to questions Mr. McIntire said this road had been in operation one summer with horse traction, and electric motors had only begun to run upon it. Mr. Cleminshaw said that there was nothing so severe on track as the pound of an electric motor. Even the heaviest trucking would not affect the joints so much. Mr. McNamara said he had seen some of the 70-lb. rail above referred to, which was laid last year on a road operated by horses and it had a pound at every joint. Mr. McIntire replied that it could not have been laid properly. Mr. Powers said that on the Glens Falls road with a 40-lb. rail he had adopted the standard three-tie angle-bar joint of the New York Central R. R., and the joints were absolutely unnoticeable. One reason for failures of electric railway track is too wide spacing of the ties. He laid ties about 2 ft. c. to c., decreasing to 16 ins. at the joints. Mr. Cleminshaw said that the secret of Mr. Powers' success was that he had single track road. He had much more trouble with the joints on double track than on single track. On an ordinary railway the bolts can be screwed up as the joint wears. On a street railway this cannot be done. There is not an electric road in existence to-day which has run one year that has got a perfect joint. His company built a road about 15 months ago with 63-lb. rail, new pavement, new ties 30 ins. c. to c., and everything first-class. It ran six months very well, but to-day it is fast going. There is no remedy. He had come nearest to success by the use of a suspended joint. The theory is taken from steam railroad practice. He had so far had no trouble with these joints, but it might come.

SEWAGE PURIFICATION IN AMERICA.

(Continued from page 285. With inset.)

Sheepshead Bay, N. Y.

As stated last week, the process used at White Plains is also in use at Sheepshead Bay, Coney Island, and Round Lake, N. Y. The purification plants at Coney Island and Sheepshead Bay, the well known pleasure resorts, are each in the town of Gravesend, on Long Island. Each plant has been built under the direction of the Town Board of Health. Sheepshead Bay is not an incorporated village. Coney Island village in 1890 had a population of 3,313 out of 6,937 in the whole town of Gravesend, so the population of Sheepshead Bay is probably 3,000 or less. Both communities have large floating populations during the summer.

The sewerage system at Coney Island was begun in 1891 and it is expected that it will be finished this fall. The purification plant is already in operation. The separate system is used. Water mains are being laid by the town in the trenches with the plant, with Mr. Horace Loomis, M. Am. Soc. C. E., New York, as Constructing Engineer.

Although the same process is used at Sheepshead Bay as at White Plains the details of construction are in some respects quite different, which is largely caused by the circular plan of the works and the fact that it was necessary to construct it on a pile foundation. The village is very flat and the surface of the ground is near the water line of the bay. The purification plant is located on marsh land subject to tide flooding near an inlet or creek.

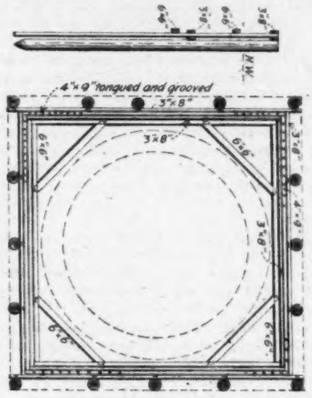


Fig. 31. Sketch Showing Method of Constructing Ca sson.

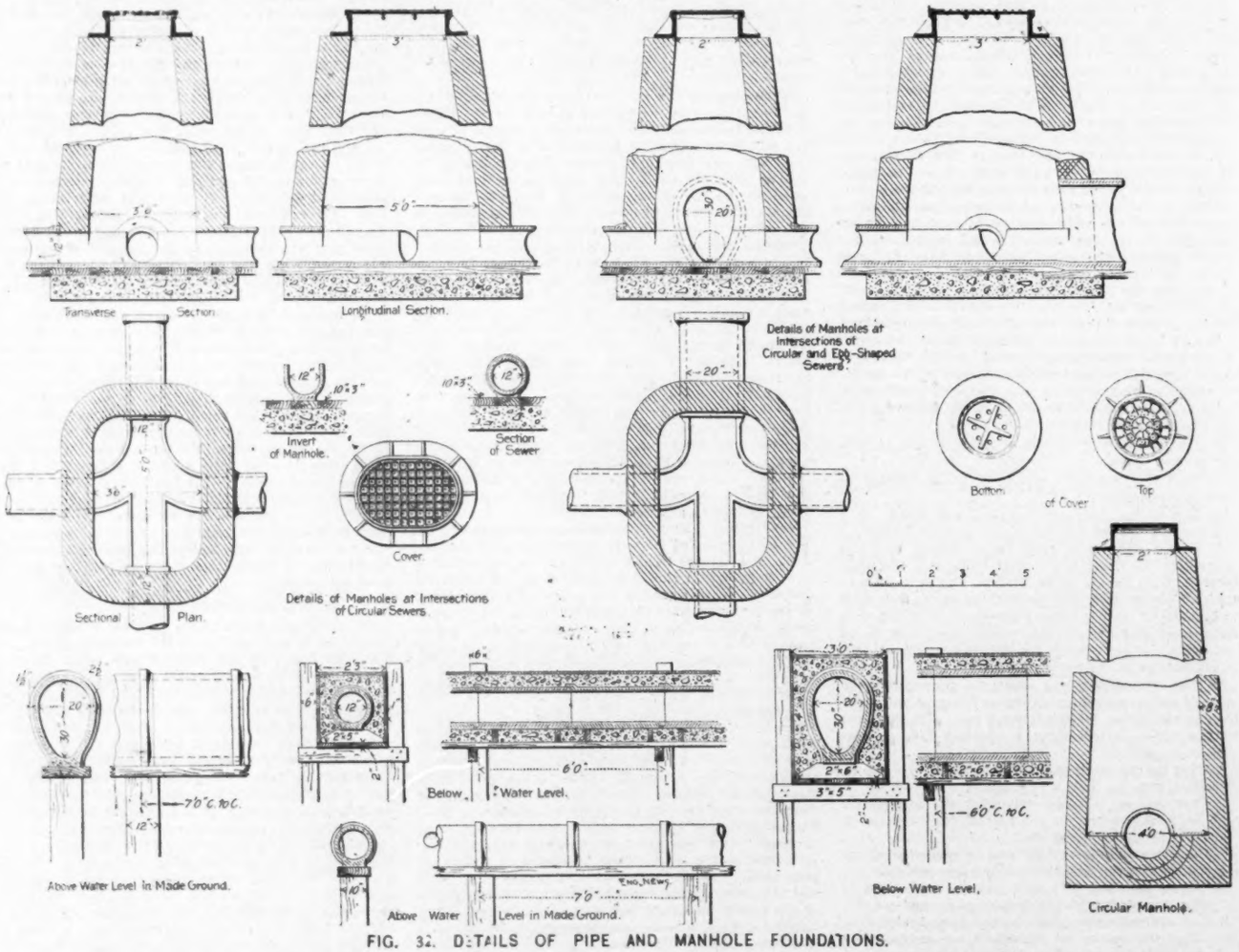


FIG. 32. DETAILS OF PIPE AND MANHOLE FOUNDATIONS.

sewers, there being about 13 miles of sewers and 15 miles of water mains. The sewers range in size from 24 to 12 ins., and are of cement. The pipe was made by Wm. G. Pierson, Brooklyn, N. Y. J. J. Powers, C. E., Brooklyn, is engineer for the

The 24-in. egg-shaped cement outlet sewer from the village comes across the marsh, turns and enters the building from the water side beneath the effluent pipe to the creek. The low levels and flat grades necessitate a deep receiving well from which the

sewage is pumped to the tanks. The plant is in the town of Gravesend.

In constructing the receiving or pump well a caisson was used. The accompanying sketch in the text, Fig. 31, gives a good general idea of the way the cassion was constructed. A water jet was used in sinking the 5×9-in. tongued and grooved sheet piling, which was sunk 25 ft. below the "meadow."

The pile foundations for the main building are shown by Fig. 24, on the inset. The sections Figs. 25, 26, 28 and29 and the developed section, Fig. 27, also on the inset, in connection with the description last week of the plant at White Plains, show the construction and arrangement and general operation of the whole plant.

The lime is discharged into the sewage while the latter is in the pump well, after which the sewage is pumped into the tanks. The location of the pumps and their suction and discharge pipes are shown in plan in Fig. 25, section A A. The sewage flows as indicated by the dotted line in Fig. 25 and as can be better understood by aid of the developed section, Fig. 27. There are no final settling tanks. The perchloride of iron is discharged into the chamber, from which the sewage is siphoned to the effluent chamber and pipe.

The details of the turntable in connection with the tram car and tramway are shown in Fig. 30.

In order to screen the sewage before it passes to the pumps it is discharged onto the platform screens shown in plan in Fig. 25 and in section in Fig. 29. A length of sheet iron pipe, mounted on rollers, shown by Fig. 31, is used to extend the inlet sewer so that the sewage may be discharged on the opposite screen while the first one is being cleaned, and vice versa. In practice it has been found that one screen answers all purposes.

Two 50-HP. Wheaton-Harrison safety boilers, made by the Harrison Safety Boiler Works, Germantown Junction, Pa., are in use. The pumps are Deane, one 12, 16, 18-in., rated at 1,500,000 gallons and the other a 16, 22, 24-in., rated at 3,000,000 gallons daily.

A 6-in. centrifugal pump, driven by steam, and having a 6-ft. lift, was provided for handling the sludge but it is not used. Sawdust is now mixed with the sludge as an absorbent, after which it is shoveled into buckets, hoisted from the tanks and pushed out in the tram cars as at White Plains. The sludge is used to fill in about the building and was wholly inoffensive when the writer was at Sheepshead Bay, Sept. 12, as was everything else about the plant. The whole building is heated by steam and the village water supply is extended to the plant.

The effluent here, as at White Plains, was slightly clouded. This seems to be admissible here, as does the omission of the final settling tank, for the effluent goes into a considerable creek of salt water. It is doubtful, however, whether the use of perchloride of iron at or near the time of siphoning is of especial advantage without the final settling tanks.

Chlorine generators are provided and the gas is used in the manner described last week under White Plains.

The saturated sand in which many of the sewers were laid at Sheepshead Bay, and also at Coney Island, necessitated especial care in preparing foundations. The details of the pipe and manhole foundations at Sheepshead Bay are given in Fig. 32. The 6×6-in. piles were driven 9 ft. below low water mark, 6 ft. c. to c. The circular manholes were used where there was plenty of depth and the others in shallow places. All the 18 and 24-in. cement pipe used is egg-shaped, proportioned to give a flow equal to 18 and 24-in. circular pipe. The hubs are 2½ ins. deep.

Provision is made for flushing the sewers from hydrants supplied by special flushing mains. Mathews hydrants with 4-in. branches and two 2½-in. connections are used.

Details of the works at White Plains, some of which are common to all the plants using this process, will be given in a later issue.

RATE OF LAYING PAVING BRICK.

Brick pavement for streets is becoming so popular in many sections of the United States that any information connected with it is interesting to our readers. In Engineering News of Sept. 15 a correspondent asked concerning the rate of laying paving brick, and in lack of other data we quoted Trautwine for common bricklaying in house work. It seems we were very much out, according to the following figures sent us by Mr. George W. Walker, Jr., of Jacksonville, Ill.:

Mr. Walker says: I have obtained from M. E. Shoemaker, foreman of paving at Carlinville, Ill., the following figures in regard to laying brick pavement: He says an average laborer will lay 15,000 bricks per 10 hours when the surface is prepared ready for receiving the brick. Pat Murphy, an expert brick paver, will lay 20,000 per 10 hours; at one time he laid 13,428 brick in 4 hours, 28 minutes, or at the rate of 30,060 per 10 hours. This is simply laying the brick and of course does not include preparing the surface or delivering the brick.

From Monday, Sept. 19, 1 p. m., to Tuesday, Sept. 20, 4 p. m. (13 hours), nine men under unfavorable circumstances, prepared the surface and laid 37,000 bricks and covered the last course with sand. This includes all the work of laying the pavement (which at Carlinville is done quite carefully) except sweeping in the sand on the top course. This is 3,162 brick per man per 10 hours, nearly completed pavement, or 6,324 for man and one helper in 10 hours.

COST OF CONCRETE BASE FOR PAVEMENT AT TORONTO, ONT.

During 1890-91 the city of Toronto, Ont., laid by day labor 14,579 sq. yds. of concrete base or foundation for pavement on King street. The detailed cost of the work is given in the last report of the city engineer of Toronto, from which the figures below are abstracted.

The concrete was composed of one part Portland cement, 7½ parts broken stone and 2½ parts gravel sand. There were laid 14,579 sq. yds. to a depth of 6 ins., or 2,430 cu. yds. of concrete. The material used and cost were as follows:

	Cost.	Cost per ft., cts.
1,885.7 bbls. Portland cement, at $2.77½.	$5.238	35.8
237 cu. yds. broken stone, at $1.91	3.481	23.8
648 " gravel ard sand, at 80 cts.	518	3.6
Labor (15 cts. per hour)	2.512	17 3
Totals	$11.749	80.5

Mr. Granville C. Cunningham, M. Inst. C. E., was City Engineer when the report was made. Mr. E. H. Keating now fills that position.

THE AMOUNT OF DISSOLVED OXYGEN CONTAINED IN WATERS OF PONDS AND RESERVOIRS AT DIFFERENT DEPTHS.*

The interesting changes in the character of the water of deep ponds, consequent on the stagnation and circulation of the water at different seasons of the year, was discussed in the special report of the Massachusetts State Board of Health, on the Examination of Water Supplies, 1890, pages 749-767. Investigations of the temperature and composition of the water from different depths in deep ponds showed the presence, in the warmer months, of a stagnant layer of water below a depth of 20 ft. from the surface. If the surface of the pond is undisturbed by winds it may reach even to a greater height, say 10 ft. from the surface. This stagnant layer begins to form in the early part of April, and mingles with the surface water when the circulation of the water takes place in the autumn. This mingling begins in the early part of October and is completed some time in November.

It was stated in the account of this special investigation of deep ponds that the composition of this stagnant water depended upon the amount and character of the impurities in the water and on the character of the bottom of the pond, whether or not it contained much decomposable organic matter. Thus of seven deep ponds or reservoirs examined it was found that the amount of free ammonia which may be taken as a measure of the amount of decomposition going on in the stagnant layer, varied from 0.4720 parts per 100,000 in Jamaica Pond, Boston, to 0.0008 parts in the bottom of Reservoir No. 4 of the Boston water supply in Ashland. That the results in these two cases are not accidental is proved by repeated examinations of the deep layers in both of these bodies of water, extending over several years.

The freedom from products of decomposition in the latter case, namely, Reservoir No. 4, is due to the fact that the water is derived from an unpolluted watershed; that the organic matter which it contains is derived mainly from swamps and is very slightly disposed to decomposition, and also to the fact that all soil and vegetable matter was carefully removed from the bed of the reservoir before it was filled with water. On the other hand, Jamaica Pond is in a populated region and the bottom contains much readily decomposable organic matter.

In connection with this investigation of the composition of water at different depths it was of interest to determine the amount of dissolved oxygen in the water in the different layers. This determination is best made on the spot, since there is danger of the samples absorbing oxygen from the atmosphere during the transportation to the laboratory.

During the summer of 1891 a considerable number of determinations of the dissolved oxygen were made at different depths, in the waters of many ponds and reservoirs.** The water was pumped up, under proper precautions to prevent access of air, into bottles of known capacity and the chemical reagents were added immediately.**

Following are the results of some of the determinations thus obtained. The amount of oxygen present is in all cases expressed as percentages of the amount required to saturate the water at the temperature when collected.

Dissolved Oxygen at Different Depths in Various Ponds and Reservoirs.

Jamaica Pond, Boston.—June 11, 1891.

Depth.	Temperature of water, Fahrenheit.	Per cent. of oxygen.
Surface	77.	100.00
10 ft. below surface	68.	100.00
20 " "	68.	80.00
30 " "	53.6	59.03
40 " "	53.6	11.10
50 " "	—	0
57 " " bottom	—	0

June 25, 1891.

Depth.		
Surface	71.	100.00
35 ft. below surface	42.4	37.11
40 " "	42.4	0
50 " "	42.	0

July 14, 1891.

Surface	75.4	100.00
10 ft. below surface	75.	100.00
20 " "	54.	49.00
30 " "	42.4	28.47
35 " "	42.	4.78
40 " "	42.	0
47 " "	41.3	0

Glen Lewis Pond, Lynn.—June 26, 1891.

Depth.		
Surface	75.5	100.00
5 ft. below surface	—	100.00
7 " "	—	10 [illegible]
10 " "	—	0
13½ " "	63.	0.00

Scott Reservoir, Fitchburg.—July 29, 1891.

Surface	70.5	87.20
10 ft. below surface	65.8	78.70
20 " "	61.1	32.11
25 " "	50.3	10.57
30 " "	—	0
35 " " (bottom)	—	0

The sample from the bottom had a strong odor of sulphureted hydrogen; that from the depth of 30 ft. a faint odor. The samples were taken near the gatehouse.

Lynde Brook Reservoir, Worcester.—July 15, 1891.

10 ft. below surface	70.	93.01
25 " "	61.	29.14
30 " "	51.8	0
35 " " (bottom)	51.8	0

The samples at 30 and 35 ft. had a strong odor of sulphureted hydrogen.

Lake Cochituate, Boston Water-Works.—Aug. 17, 1891.

Surface	74.7	79.15
10 ft. below surface	66.4	85.61
20 " "	53.6	35.96
30 " "	49.3	24.33
40 " "	48.2	20.53
45 " "	48.2	1.05
50 " "	45.7	0
57 " " (bottom)	44.9	0

The odor of the samples which contained no oxygen was not offensive; simply earthy.

Reservoir No. 3, Boston Water-Works.—Aug. 20, 1891.

Surface	74.7	85.88
6 ft. below surface	74.7	85.06
12 " "	70.9	58.97
14 " "	—	0
15 " "	—	0
17 " "	—	0
19 " "	—	0
21 " " (bottom)	62.8	0

Reservoir No. 4, Boston Water-Works.—Aug. 20, 1891.

Surface	74.7	84.50
10 ft. below surface	70.9	84.42
20 " "	61.9	28.2
30 " "	70.	27.42
35 " "	54.7	16.28
36½ " " (bottom)	54.7	15.10

The contrast in the condition of the water in these two reservoirs is very striking. Reservoir No. 3, in which the oxygen is exhausted at a depth of 14 ft., receives a not inconsiderable amount of direct pollution from the towns of Marlborough and Southborough, while the drainage area of Reservoir No. 4, as has been already said, is very sparsely populated.

Springfield Water-Works.

Large Ludlow Reservoir.—July 16, 1891.

Surface	75.4	97.85
10 ft. below surface (bottom)	74.7	61.17

* By Thomas M. Drown, M. D., Chemist of the Massachusetts State Board of Health. From the forthcoming Report of the Board for 1891.

* This collection and analysis of these samples were made by Dr. A. H. Gill, of the Massachusetts Institute of Technology.

** L. W. Winkler's process (described in the volume on Purification of Sewage and Water, 1890,) was used and it is to be recommended for its convenience, simplicity and accuracy. Winkler's original article in the "Berichte," vol. 21, p. 2843.

Small Ludlow Reservoir; Gate House.

Surface	75.4	77.60
13 ft. below surface (bottom)	74.7	70.58
Faucet at Indian Leap Hotel, after passing through six miles of pipe.	74.7	60.76
Faucet at Winchester Park, after passing through three additional miles of pipe.	74.7	56.98

Van Horn Reservoir, Springfield.—July 16,1891.

Surface	75.4	100.00
7 ft. below surface	75.4	100.00
14 " "	75.4	46.43
17 " "	—	0
20 " "	—	0
28 " " (bottom)	—	0

In all cases in Jamaica Pond the layers of water which contain no dissolved oxygen have an offensive odor from carbureted and sulphureted hydrogen. The Jamaica Pond series also well illustrates the increase in the thickness of the oxygen-free, stagnant layer as the summer advances.

Glen Lewis Pond, Lynn, is an artificial reservoir, from which the surface soil was not removed. It was first flooded in the latter part of 1889. The water has always contained a large number of animal and vegetable organisms which give it, at most seasons of the year, a very disagreeable appearance and odor. The fact that the oxygen was proved to be about 10 ft. from the surface in this pond may be due to the fact that the reservoir is comparatively small (36 acres) and well sheltered from the wind by hills on both sides. It may also be true that the decomposition of the organic matter in this pond is particularly rapid.

The odor of the water at 10 ft. below the surface was disagreeable, and that at 13 ft., very offensive. It is interesting to note in this case the abrupt transition, within a distance of 3 ft., from a water fully saturated with oxygen to one in which the oxygen has been entirely exhausted. This is doubtless owing to the fact that the upper 7 ft. of water were in circulation through the effect of the wind, and thus exposed to the atmosphere at the surface; because we must assume that at this high temperature decomposition must also be active in the upper layers.

Walden Pond, Lynn, is of the same general character as Glen Lewis Pond. Its depth where samples were taken (June 26, 1891) was 10 ft. At this depth the oxygen was only 12.84% of that required for saturation, and at the surface there was 83.1%.

In connection with the determination of dissolved oxygen in the Ludlow Reservoir, of Springfield (which contains at all seasons of the year an excessively large number of organisms in suspension in the water), an attempt was made to ascertain whether the amount of dissolved oxygen decreased in the water in its passage through the pipes. It was found that the amount of oxygen was somewhat less after a passage of six miles in the pipes. But the differences are not very great, and it is possible that the loss of oxygen may in part be due to other causes than the decomposition of organic matter.

The reservoir is only 10 or 13 ft. deep at the points where the samples were taken, and the comparatively large amounts of oxygen found in the bottom layers of the water indicate, probably, that the water in the reservoir was in circulation by means of the wind.

Some of the water on leaving the pipe passes into an open ditch 500 ft. in length, and then flows swiftly through a trough with a steep grade into Van Horn reservoir. A sample taken at the beginning of the ditch showed 77.49% of dissolved oxygen, and a sample at the end of the trough 91.28%. These results are somewhat too high, owing to the impossibility of collecting the samples without access of air; but the greater amount of dissolved oxygen in the water as it flows into the reservoir may be said to represent fairly the effect of aeration in the open ditch or trough.

Van Horn reservoir receives, in addition to the water of Ludlow reservoir, a certain amount of water from its own watershed (about 250 acres), which enters the reservoir mainly after filtering through the ground.

The water from the depth of 17 ft. had an earthy odor; that from the 20 and 28-ft. layers, a strong odor of sulphureted hydrogen.

A consideration of the foregoing determinations of dissolved oxygen in the waters of ponds and reservoirs of different characters leads us to two important conclusions:

(1) That the stagnation of water is not in itself objectionable.

(2) That when a water contains decomposable organic matter, or where water is stored in reservoirs having decomposable matter on its bottom and sides, the oxygen in the water will be quickly used up, and if not renewed the water will become foul.

Reservoir No. 4, of the Boston water supply, is the only deep reservoir among those examined which contained some dissolved oxygen (15½%) in the stagnant layer, and this was as late in the summer as Aug. 20. It is not improbable that many natural unpolluted ponds, with sandy bottoms, would show even a larger amount of oxygen in the stagnant layer than Reservoir No. 4. If there is nothing to use up the oxygen in solution in the water there is no reason why it should not remain indefinitely. There is always, however, some organic matter in all surface waters, and it is probable that the stagnant layer even in the best ponds is never fully saturated with oxygen. The ordinary process of decomposition of organic matter is one of oxidation, and is not necessarily accompanied by offensive odors. In all surface waters which contain vegetable and animal life decomposition is constantly going on, and yet in the presence of an abundance of oxygen there is seldom any objectionable odor; but when the oxygen is exhausted, putrefactive changes set in and the products then formed are highly offensive. It is under these conditions that sulphureted, carbureted and phosphoreted hydrogen are developed. These gases we find in water only when oxygen is absent.

In practical water-works management, advantage may be taken of the fact of the formation of a stagnant layer in the bottom of deep ponds and reservoirs by drawing the water from near the surface in those cases in which the stagnant layer is foul; but the deterioration of the surface water cannot be prevented when the mingling of all the water takes place in the autumn. In deep storage reservoirs, which must be drawn very low in order to maintain the supply, it may become necessary to draw from the stagnant layer, and if this layer contains products of putrefaction, bad water is supplied.

saying that it was "the only flag of any nation that had floated on the east coast of Greenland above 77°, and had been carried along the northern boundary of the mainland."

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

CENTRAL ONTARIO.—The line is to be extended about 5 miles at its south end along West Lake, and is also to be extended through Picton, Ont., to the water front. An extension northward from Coe Hill to lumber districts is also talked of.

SANDUSKY & COLUMBUS SHORT LINE.—45 miles of track have now been laid on this railway from Sandusky, O., south to Columbus, O. The road will be completed to Bucyrus, O., in about 60 days.

GEORGES VALLEY.—The force of 40 men and 12 teams is now at work on the extension of this railway from Warren to Union Common, Me., and 50 more men will be added this week. The line is now graded nearly to the Waldoboro road.

GOUVERNEUR & OSWEGATCHIE.—This line between Gouverneur and Edwards, N. Y., is about half completed; there are several heavy rock cuts along the line, but work is making favorable progress and the contractors think it will be completed by November 15.

WABASH.—W. P. Chapman & Co., of Elgin, Ill., have been awarded the contract for tracklaying and ballasting on the extension from Montpelier, Ohio, to Hammond, Ind., a distance of about 165 miles.

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF AUGUST, 1892.

[Furnished to Engineering News by the Department of Agriculture.]

	Station.	Temperature. (Deg. Fahr.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max.	Direction at time of max. velocity.	Precipitation—(Rain and melted snow)—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	64.8	89	43	46	6.4	48	W	6.50	1.60	15
	Portland, Me.	66.2	84	46	38	7.2	26	NE	8.14	2.47	14
	New York City.	73.9	93	59	34	6.9	28	NE	3.99	1.39	12
	Pittsburg, Pa.	73.5	93	56	37	5.5	24	S	2.22	0.68	7
	Chicago, Ill.	70.9	93	50	43	13.8	40	S	1.85	0.61	8
	Omaha, Neb.	73.4	100	49	51	5.8	30	NE	2.53	0.83	7
	St. Paul, Minn.	69.4	87	44	43	5.6	42	NW	3.66	1.38	8
	Duluth, Minn.	66.8	86	44	42	4.9	36	N	4.28	1.94	8
	Bismarck, N. Dak.	68.5	98	41	57	8.4	36	NW	2.40	1.33	10
	Average	69.7	91.4	48.0	43.4	7.2	34.4	.....	3.92	1.36	10
Southern Cities.	Washington City.	76.2	95	60	35	4.8	18	NW	0.85	0.64	5
	Louisville, Ky.	76.6	93	53	40	5.7	26	N	1.84	1.16	9
	St. Louis, Mo.	77.8	97	58	39	8.1	32	SW	1.75	0.95	7
	Savannah, Ga.	81.2	96	70	26	6.2	28	E	3.36	0.89	19
	Leavenworth, Kan.	76.2	98	51	47	6.0	42	SW	3.54	2.12	8
	Jacksonville, Fla.	81.4	96	68	28	5.7	31	SW	4.84	1.40	20
	Chattanooga, Tenn.	76.1	91	62	29	4.0	23	N	5.61	0.78	17
	New Orleans, La.	81.7	92	70	22	6.0	27	NE	6.96	3.85	12
	Memphis, Tenn.	78.7	95	61	34	5.2	30	SW	3.52	1.59	8
	Palestine, Tex.	80.5	94	65	29	4.4	22	NE	3.41	2.02	6
	Average	78.6	94.7	61.8	32.9	5.6	28.8	.....	3.57	1.54	11
Western Cities.	Helena, Mont.	66.0	94	41	53	7.2	36	SW	0.48	0.15	9
	Port Angeles, Wash.	57.4	82	43	39	6.2	24	W	0.40	0.19	5
	San Francisco, Cal.	59.4	92	50	42	10.4	28	W	0.00	0.00	0
	Salt Lake City, Utah.	75.4	100	45	55	5.9	28	SW	0.05	0.03	2
	Denver, Colo.	71.4	98	45	53	6.6	28	NW	0.58	0.36	5
	Yuma, Ariz.	90.8	114	66	48	6.8	38	SE	0.02	0.02	1
	Santa Fé, N. Mex.	68.2	86	46	40	7.1	31	NE	0.81	0.25	8
	Average	69.8	95.1	48.0	47.1	7.2	30.4	.....	0.33	0.14	3

It is not uncommon to find iron in solution, in considerable amount, in the bottom layers of water in deep ponds, when the oxygen is exhausted. Insoluble iron oxide may, under these conditions, be reduced to the lower oxide, and go into solution. In such cases the water may be colorless when pumped up from the bottom, but it quickly becomes turbid on exposure to the air, and iron oxide separates out, on standing, as a red deposit.

No stronger argument for vigilance in preventing the contamination of a water supply, and for its storage in clean reservoirs, could be made than is contained in the results of the foregoing investigation of the changes which organic matter undergoes in water, involving the exhaustion of the dissolved oxygen and the formation of putrefactive products. How far we may expect to remedy the evils consequent on the presence of decomposing organic matter in water by aeration will be discussed in the next chapter of this report.*

Mr. R. E. Peary, in his verbal report to the Academy of Natural Sciences, of Philadelphia, said that he had carried out to the letter the programme of the Academy. He believed he had settled the northern limit of the mainland of Greenland; and knew of the existence of enormous glaciers in all the northern fiords. He had completed the survey of Whale Sound, Davis Bay and Inglefield Gulf. He had exceptional facilities for studying the Esquimos of Northern Greenland, the Arctic highlanders, and he says their skill in adapting means to ends is phenomenal. Mr. Peary returned to the Academy the silk American flag,

* See Eng. News for Aug. 25, 1892, "The Effect of the Aeration of Natural Waters."

OLD COLONY.—The Railroad Commissioners of Massachusetts are holding a hearing on the petition of the Old Colony road for an extension from a point on the main line in the town of Sherborn to West Roxboro. The proposed line will give the northern division a direct connection with Boston and has already been surveyed.

INDIANA, ILLINOIS & IOWA.—According to press dispatches, the prospects seem favorable for the early commencement of work on the proposed extension from Knox to South Bend, Ind. It is stated that bonds to the extent of $500,000 will be issued and that bids for construction will be called for in a few days.

CINCINNATI, HAMILTON & DAYTON.—This company is completing a spur 5 miles long from Wellston, O., to Gilroy, O.

LANCASTER, CECIL & SOUTHERN.—Four miles of this road between Childs Station, Md., and Garrett's wall paper mills has been completed. It is now stated that surveys for the line from Providence to Oxford, Pa., 9 miles, will be commenced in October.

BALTIMORE & OHIO.—This road has just finished widening to double track, four miles of road from Rockville, Md., to Garrett Park, on the Metropolitan Branch. There still remains unfinished one mile of the five which was formerly single track. The work is very heavy, including a 50-ft. arch at Rock Creek, replacing the bridge and trestle now there. Mr. W. L. Sisson is Resident Engineer.

Projects and Surveys.

ALLEGHENY & SOUTH SIDE.—Chartered in Pennsylvania with a capital stock of $50,000 to build a railway running from Spruce St., Allegheny City, on the Ohio River, to a point in the 26th Ward of Pittsburg, on the tracks of the Monongahela Connecting railway at So. 24th St., a distance of about 25 miles. Pres., William Jenkins, Pittsburg, Pa.

TROY & NEW ENGLAND.—The second survey of this line from Troy, N. Y., east to a connection with the Lebanon Valley R. R., has been completed. It is thought that the engineer's report to the directors of the company will be made this week, and immediately after work will begin toward the construction of road.

OSCAWANA & CORNELL.—At a recent meeting of the directors of this company the following officers were elected: Pres., William H. Gale; Treas., Isaac B. Noxon; Secy., A. S. Houghton; Ch. Engr., Oliver W. Barnes; General Council, Root & Clarke, 32 Nassau St., New York City. The road will be about 4.1 miles in length and will run from Oscawana Station to a point near the site of the new Cornell dam.

Southern.—Existing Roads.

NORFOLK & WESTERN.—Tracklaying has been completed on the Ohio extension, running from Elkhorn, W. Va., to Ironton, Ohio, crossing the Ohio River at Ceredo, W. Va.

SOUTH BOUND.—At a recent meeting the stockholders of the Florida Central & Peninsular Ry. confirmed the contract made for the lease of the South Bound R. R. It is stated that President Duval is now in Europe perfecting financial arrangements for completing the extension from Savannah to a connection with the Florida Central and Peninsular Ry. Work is now in progress surveying and securing the right of way, and it is stated that construction will commence about November 1. Mr. D. A. Denmark has been elected President of the South Bound R. R., in place of H. M. Comer, who recently resigned his position.

CHARLESTON, CLENDENIN & SUTTON.—About 6 miles of track have been laid on this line from Charleston, W. Va., north, and 3 miles additional are graded ready for tracklaying. Work is being rapidly pushed, and it is expected that Clendening will be reached by Christmas.

Projects and Surveys.

HARRIMAN & PORT ROYAL.—A railway company by this name has been chartered in Tennessee.

HOLSTON VALLEY.—Surveys have been commenced on this proposed railway from Bluff City to Damascus, Tenn., a distance of about 25 miles. Officers of the company are as follows: Pres., H. W. Dyer, Detroit, Mich.; Gen. Mgr., A. F. Willey, and Sec'y, Robert Willey, both of Bristol, Tenn.

Northwest.—Existing Roads.

AHNAPEE & WESTERN.—Fourteen miles of track have been laid on this road from Casco Junction to Ahnapee, Wis., and grading is now in progress on the line from Ahnapee to Sturgeon Bay. Pres., E. Decker, Ahnapee, Wis.

CHICAGO, ROCK ISLAND & PACIFIC.—The contracts for the construction of the line from Lincoln, Neb., to Jansen, Neb., 54 miles, have been let. Among the contractors are James O'Shea, Capt. Weare & Son, Bethune & Craney, McCormick Bros., J. D. McNeely, and others.

PORT ARTHUR, DULUTH & WESTERN.—Only 6 miles more of this line remains to complete it to the international boundary.

Projects and Surveys.

ELEVATED TERMINAL RY. CO., OF CHICAGO.—This company has been incorporated in Illinois with a capital stock of $7,500,000. The Directors are Walter C. Gunn, John H. Miller, Andrew Gillespie, Paul Brown and William G. Adams, all of Chicago.

BAYFIELD HARBOR & GREAT WESTERN.—W. F. Dairymple has purchased the stock and franchises of the Bayfield, Lake Shore & Western Ry., and will consolidate them with this company. Both companies were organized to build lines from Bayfield Harbor, Wis., west to a connection with the Northern Pacific R. R.

CHICAGO & NEW ORLEANS.—It is announced that surveys have been resumed on this line from Altamont, Ill., to Paducah, Ky., and that work is in progress, securing the rights of way, and preparing for immediate construction. The line will be about 130 miles long, and is supposed to be in the interest of the Wabash Ry.

Southwest.—Existing Roads.

TEXARKANA & FORT SMITH.—Twelve miles of track, extending this line from Ogden to Wilton, Ark., have been laid this year.

KANSAS CITY, NEVADA & FORT SMITH.—Work is now in progress between Hume, Mo., and Clayton, Mo., 18 miles. The contractors are the Missouri Coal & Construction Co. Surveys have been completed from Clayton, Mo., to Pittsburg, Kan., 30 miles. Ch. Engr., J. H. Collins, Kansas City, Mo.

Projects and Surveys.

SABINE PASS, ALEXANDRIA & NORTHWESTERN.—Chartered in Texas to build a railway from Sabine Pass, Jefferson Co., north to a connection with the Chicago, Rock Island & Pacific R. R. in Wise Co., with a branch from main line at San Augustine to Durst, Angelina Co., Tex. Among the incorporators are R. B. Hubbard, J. P. Douglas and H. H. Rowland, all of Tyler, Tex.

KANSAS CITY, JOPLIN & SOUTHWEST CITY.—A surveying party under the direction of S. J. McKee, of Joplin, Mo., is locating this line between Joplin and Southwest City, McDonald Co., Mo. This company was chartered about a year ago with J. C. Seabourne as President.

ARKANSAS MINERAL BELT.—Chartered in Arkansas, Sept. 27, to build a railway from Little Rock north, via Pulaski, Faulkner, White, Cleburne, Van Buren, and Stone counties to the northern line of Baxter Co. It is intended further to extend the line to West Plains, Howell Co., Mo., making the total length about 175 miles. Pres., C. P. Huntington; 1st V.-P., J. R. B. Moore; 2d V.-P., W. H. Toothaker; Sec. and Treas., Will L. Thompson.

CLAYTON & PEA RIDGE R. R. COAL CO.—Chartered in Arkansas, Sept. 22 with a capital stock of $200,000. Thos. J. Clark, of Pea Ridge and C. A. Weaver, of Clayton, are interested.

Rocky Mt. and Pacific.—Existing Roads.

SANTA FE, PRESCOTT & PHOENIX.—A press dispatch quoted in our last issue stating that the construction of this line through Arizona had been abandoned owing to the difficulty of building through the mountains is said to be without foundation. The more recent dispatch states that several hundred men are employed and that tracklaying is progressing at the rate of a mile a day. E. M. Dickey, Treasurer of the company, is quoted as follows in regard to the report. "The report published in the papers in regard to the suspension of work on our line is absolutely false. Grading and tracklaying are progressing as fast and with as many men as can be worked to advantage. The road will be finished into Prescott this fall. The report that the work had been stopped grows out of the fact that a small contractor ran away and some enemies of the company circulated the report to injure us. The road is being built under a favorable and exclusive traffic contract with the Atchison, Topeka & Santa Fe, and will be not only a good feeder for that line, but a factor of importance in developing the agricultural and mineral resources of Arizona."

Projects and Surveys.

BUTTE, ANACONDA & PACIFIC.—It is announced that construction will begin at once upon this railway from Butte to Anaconda, Mont. The surveys for the line were made some time ago. Marcus Daly, of Anaconda, Mont., is at the head of the enterprise.

PORTLAND & MT. HOOD.—A company has been organized to build a single rail railway from Portland to Mt. Hood. The capital stock is $1,000,000. Among the incorporators are J. M. Strowbridge, O. C. Yocum, Thomas J. Hammer and others, of Portland, Ore.

ELECTRIC RAILWAYS.

BUFFALO, N. Y.—The directors of the Buffalo & Williamsville Electric Ry. Co. will let contracts for the construction and equipment of an electric railway from Buffalo to and through the village of Williamsville, N. Y. The road will be 4½ miles long and will be a continuation of the Main Street line of this city. Plans, specifications, etc., are on file at the office of the company's engineers, Voorhees & Witmer, Chapin Block, Buffalo, N. Y.

NORTH TONAWANDA, N. Y.—The Tonawanda Electric Street Ry. Co. has been granted a franchise by this village.

HAZELTON, PA.—Work will soon be commenced on the electric line. Mr. P. J. Ferguson, of Shenandoah, Pa., is interested.

PITTSTON, PA.—Pittston, Jenkins & Avoca Street Ry. Co.; $50,000; commencing business with $10,000. Pres., Thos. English.

MONTGOMERY, ALA.—West End & Riverside Electric Ry.; $100,000; Dr. S. D. Seelye, M. E. Satchwell and J. M. Garrett, Jr.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The Seaside Elevated R. R. Co. has secured bids for the building of its line to Cypress Hills Cemetery, forming an extension of the Brooklyn Elevated R. R.

CHICAGO, ILL.—The Elevated Terminal Ry. Co. has been incorporated to build a loop line from a point north of Washington St., between Fifth Ave. and the Chicago River, to a point between Adams and Polk Sts.; thence to a point between State St. and the lake; thence to some point north of Randolph St., on the south and the Chicago River on the north; thence west or southwest to the place of beginning. Capital stock, $7,500,000. The incorporators are Walter C. Gunn, John H. Miller, Andrew Gillespie, Paul Brown, William G. Adams and Underwood & Green.

HORSE RAILWAYS.

PHILADELPHIA, PA.—Engelside R. R. Co.; $50,000. Pres., W. J. Latta.

GALESBURG, ILL.—Galesburg West Side Street Ry. Co.; $75,000; S. Frohlich and N. P. Glam.

CHICAGO, ILL.—Jefferson Street Ry. Co.; $500,000; Geo. N. Parker and J. R. Bickerdike. Chicago Traction Co., $1,000,000; Charles Vogel and T. O'Brien.

DULUTH, MINN.—A contract has been let by the Duluth Street Ry. Co. to W. C. Doherty to build an extension to Lakeside. This will make the Superior St. line about 15 miles long, and it is to be completed by Nov. 15.

HIGHWAYS.

NEW YORK.—The village of South Mt. Vernon has appropriated $22,000 for the purpose of macadamizing the White Plains road.

MARYLAND.—Arrangements are being made to send a corps of engineers over the route of the proposed boulevard between Baltimore and Washington. It is said the turnpike between the two cities, which the company has the right to use under an act of the legislature, will not be followed strictly in construction the boulevard. Owing to the turnpike's grades it will be necessary to diverge at many places. The engineers will select the location of these changes at points which offer the easiest grades. It is not expected that the active work of construction will begin until next spring, as but slow progress can be made in the winter.

TEXAS.—The city engineer of El Paso has estimated the cost of a road out to the smelter at $15,831. This estimate is for road built of slag from smelter, the total length to be 3,650 ft. and width 30 ft. It includes the building of three bridges and the road will be 2 ft. above extreme high water. The Mayor stated that the county proposed to donate $2,000 or $3,000 to the building of this road and the city would have to stand the balance. The report was referred to the street and grade committee.

WATER-WORKS.

New England.

MEREDITH, N. H.—It is estimated that works can be built for $35,800.

PITTSFORD, VT.—Preliminary estimates by Engrs. Chappell & Burke, Rutland, place the cost of works at $23,000. A supply from a spring, with a reservoir, is projected. Subscriptions for a stock company are being secured by J. M. Goodnough and Frank Denison.

MILLBURY, MASS.—A company, to be known as the Millbury Park Forestry & Water Co., is being organized to supply water and lay out a park.

WICKFORD, R. I.—A company is proposed, in which it is said that Ayrault Bros., Tonawanda, N. Y., will be interested. Address Col. T. J. Pierce.

Middle.

BABYLON, N. Y.—The Babylon Water-Works Co. has been incorporated; $75,000; Directors, Washington F. Norton, Babylon; John E. Ireland, Amityville; Timothy F. Neville, Lindenhurst, and others.

CARTHAGE, N. Y.—The contract for works has been awarded to Moffett, Hodgkins & Clarke, 16 William St., New York, for $46,500.

DEPEW, NEAR BUFFALO, N. Y.—It is reported that the engineers of the Depew Land Improvement Co. have found springs about 2½ miles distant which will afford a water supply, at an elevation of 40 ft.

GRAVESEND, N. Y.—The works of the Kings County Water Supply Co. will be sold on foreclosure for the bondholders, who will probably bid in the property.

POUGHKEEPSIE, N. Y.—It is reported that the city has awarded the contract for a 5,000,000-gallon pumping plant to the Holly Manufacturing Co., Lockport, N. Y., for $29,500. Some of the other bids were given in our issue of Sept. 15.

JERSEY CITY, N. J.—The Board of Street & Water Commissioners has instructed Chf. Engr. W. W. Ruggles to prepare plans and specifications for a new water supply.

BOONTON, N. J.—The town has appropriated $100 for a survey of possible source of water supply.

CHESTER, N. J.—It is reported that the town has voted for works and for incorporation.

ALLEGHENEY, PA.—It is reported that the city cannot legally raise the proposed $250,000 for a new water supply, and that the matter has been postponed until after the November elections.

FLEETWOOD, PA.—It is reported that the borough has decided to introduce water.

MANSFIELD, PA.—It is reported that the town can bond itself for only $28,000 of the $45,000 needed for works, and that parties stand ready to take a franchise giving the borough an option to buy the works in five or ten years, at cost, plus a sum, if needed, which added to the net receipts would yield the company 6% on its investment.

MARIETTA, PA.—A contract for works has been awarded to J. F. Stauffer & Son, Lancaster.

ROARING SPRING, PA.—Works are to be built by the borough. H. C. Nicodemus, Martinsburg, Engr.

Southern.

AIKEN, S. C.—The Aiken Water Co. has been incorporated; $60,000.

WEST KNOXVILLE, TENN.—The Council has granted a franchise to Lonsdale-Beaumont Water Co.

North Central.

CLEVELAND, O.—Bids for three 8×16-ft. steel tubular boilers will be received until Oct. 5. R. R. Herrick, Dir. Pub. Wks.

EVANSVILLE, IND.—It is stated that estimates for new works, including two reservoirs, place the cost at $452,000.

READING, O.—Plans for water and electric lighting plants have been made by Engr. T. A. Burch. Estimated cost, $40,000. A vote on building the works will be taken in November.

LA GRANGE, IND.—Oct. 3 the people will vote on building works.

PORT HURON, MICH.—It is reported that the Water Board will add a 12,000,000-gallon pump at a cost of $50,000.

WILLMETTE, ILL.—It is reported that I. W. Newcomer has received a contract for works for $125,000.

BELLEVILLE, ILL.—It is reported that A. M. Farnum & Co., who have a franchise for works, will begin at once to develop water from artesian wells.

DECATUR, ILL.—It is reported that a filter will be put in at a cost of $25,000 or $30,000.

WHEATON, ILL.—Works are said to be needed.

Northwestern.

WILLIAMSBURG, IA.—It is reported that plans for works have been adopted, and that construction will be started at once.

WASHINGTON, KAN.—It is reported that works costing about $40,000 will be built; also that Engr. A. A. Richardson, Lincoln, Neb., who is making plans, has found an underground supply near the city limits at a depth of 40 ft.

BASSETT, NEB.—The people have voted for works.

HELENA, MONT.—It is reported that a survey has been made for a new pipe line from Orafino Gulch.

Southwestern.

GALVESTON, TEX.—Bids may be asked for works to give a new supply of 5,000,000 gallons daily through a 36-in. main from Hitchcock.

GUTHRIE, OKLA.—New plans for works have been adopted with a view of cutting down the cost.

Pacific.

SUMMERLAND, WASH.—The Summerland Development Co. has been incorporated to operate works, and for other purposes; $10,000.

MAYFIELD AND MOUNTAIN VIEW, CAL.—The Mayfield & Mountain View Water Co. has been organized to supply water for domestic and irrigation uses; $200,000; Directors, B. C. Moore, San Francisco; M. J. Taafe, Mountain View; P. Connolly, Mayfield, and others.

SANTA ROSA, CAL.—J. W. Hartzel has applied for a franchise. He proposes to bring water from Russian River, said to be 14 miles distant, to a reservoir 250 ft. above the city. Pumps would be necessary. A company already supplies the city.

WOODLAND, CAL.—All bids for improvements have been rejected, none complying with the specifications. New bids are wanted. A pump, pipe and hydrants are needed.

AMERICAN FORK, UTAH.—The "Republican" urges that works be built.

MONTPELIER, IDAHO.—It is reported that a franchise has been granted to J. J. Cusick for gravity works with a 275-ft. head. Estimated cost $30,000 to $40,000. Electric lights are projected in connection with the works.

Canada.

PEMBROKE, ONT.—An appropriation of $55,000 for works has been made.

PARRY SOUND, ONT.—Works are being built by a Montreal firm. The supply will be taken from the sound, and pumped to an iron tank on a masonry tower, built on a hill at an elevation of about 100 ft. above the water.

ARTESIAN WELLS.

ABERDEEN, S. DAK.—The Council may let a contract for sinking a well to run the electric light plant. A well 1,500 ft. deep supplies water for the town.

CORPUS CHRISTI, TEX.—The Nueces & Rio Grande Live Stock Assn. proposes to sink an experimental well. If it proves successful others may be sunk.

IRRIGATION.

LA JUNTA, COLO.—F. T. Lewis, Chf. Engr. of the Otero Canal, has begun a survey of the line east of La Junta. It is said that this section will be built at once.

NEW COMPANIES.—Mamie Irrigation & Mill Co., Menardville, Tex.; $5,000. Deming Land & Water Co., Deming, N. Mex.; $700,000; P. R. Smith, D. C. Hobart, and others. Kittitas Valley Irrigation Canal Co., Tacoma, Wash.

SEWERS.

CONCORD, N. H.—The City Council has voted a sum not exceeding $20,000 for sewer extension.

WINTHROP, MASS.—The town has voted to construct sewers at Winthrop Highlands to cost $13,000.

WOONSOCKET, R. I.—The report of the special committee has been unanimously adopted by the Common Council and Board of Aldermen.

AMSTERDAM, N. Y.—The contract for trenching and back filling about 2,000 ft. on Division St. has been awarded to J. T. Charles at $6,398.

BATAVIA, N. Y.—The Sewer Commission has contracted with J. W. Holmes to make surveys, estimates and specifications for a system of sewerage. It is proposed to issue bonds for $300,000 for the construction of a complete system.

HORNELLSVILLE, N. Y.—Work on the sewer system has been discontinued, and it is reported that the work will be rendvertised. The contract was awarded to Miller & McDougal at about $87,000.

LANSINGBURG, N. Y.—The Board of Water Commissioners will receive bids until Oct. 3 for two 12-in. vitrified pipe sewers.

ROCHESTER, N. Y.—The contract for section 5 of the East Side sewer has been awarded to Lauer & Hagaman at $93,077 for the brick arch. The stone arch would have cost $97,653. The contract for section 4 will be awarded in a few days.

TROY, N. Y.—The Board of Contract will receive bids until Oct. 4 for a pipe sewer in Sixth Ave.

JERSEY CITY, N. J.—The Board of Street Commissioners will receive bids until Oct. 3 for 300 lin. ft. of 48-in. brick sewer, with manholes, etc.

LINDEN, N. J.—The Township Committee is taking steps to insure a sewerage system for the township.

MONTCLAIR, N. J.—The Township Committee is preparing to advertise for bids for a sewerage system.

CHESTER, PA.—The Council has voted to construct sewers in several streets.

PHILADELPHIA, PA.—The Director of Public Works will receive bids until Oct. 3 for main sewers inlets, bridges, etc., including main sewer in Passayunk Ave. and Shunk St.

WILKINSBURG, PA.—The contract for a complete system of sewerage has been awarded to James H. Harlow & Co., Pittsburg, at $140,000.

WILMERDING, PA.—The citizens have voted to issue bonds for $75,000 for sewers and street improvements.

NEW ORLEANS, LA.—The New Orleans Sewerage Co. has elected Dr. Joseph Holt president. This company was organized Sept. 15 for the purpose of acquiring the franchise granted by the city to A. A. Woods, and of constructing and operating the sewerage system therein provided for. Engineers have been at work several months, and plans will soon be submitted for a complete sewerage system.

CLEVELAND, O.—The City Auditor will receive bids until Oct. 10 for $16,000 of 5% sewer bonds.

NEWARK, O.—The City Clerk will receive bids until Oct. 10 for a tile sewer in Buena Vista St.

BAY CITY, MICH.—Mr. Hartwig, Cy. Engr., has prepared estimates for a 26×39-in. brick sewer 4,729 ft. in length in 18th St.

TERRE HAUTE, IND.—The City Clerk will receive bids until Oct. 18 for improving 14th St., including the construction of a sewer therein.

NORWOOD PARK, ILL.—The City Clerk will receive bids until Oct. 13 for a system of 12-in. vitrified pipe sewers.

WHEATON, ILL.—Plans and estimates for a sewer system are being prepared by Prout, Burnham & Russell.

FARGO, N. DAK.—The City Auditor has been directed to advertise for 30 days for bids for a system of sewers about a mile in length.

KANSAS CITY, MO.—Special committees from this city and Kansas City, Kan., are arranging for the construction of a sewer to drain the West bottoms; estimated cost, $16,000.

MEXICO, MO.—The Council has decided upon a sewer system. The mains will be 21 ins. in diameter and construction will begin at once.

DENISON, TEX.—H. L. McWillie, Cy. Engr., informs us that he is constructing 9,175 ft. of 18-in. pipe sewer from the present outfall to the Red River.

GAINESVILLE, TEX.—The Council has ordered the construction of 1,500 ft. of 20-in. pipe sewer.

LAREDO, TEX.—Estimates as to the probable cost of a system of sewerage are being made by C. Delafield, New York.

OAKLAND, CAL.—The City Engineer estimates that the proposed 5-ft. sewer in Second Ave. will cost $45,400. The length is 2,278 ft.

MONTESANO, WASH.—The citizens have voted to issue bonds for $15,000 for a sewerage system.

WINNIPEG, MAN.—The City Engineer will receive bids for two sewers.

STREETS.

ALBANY, N. Y.—The City Engineer has completed surveys and estimates for the new northern boulevard. The length is about 8,000 ft., and estimated cost $35,000.

BROOKLYN, N. Y.—Plans have been completed for the proposed extension of two miles of the Eastern Parkway. They provide for a width of 115 ft., including two 32-ft. roadways, two 15-ft. sidewalks, and a 20-ft. promenade. The present parkway is about 210 ft. wide.

BUFFALO, N. Y.—The only bids received for paving five streets were those of the Buffalo Paving Co., aggregating about $68,000. The lowest bid for paving Tifft St. was that of P. B. McNaughton, $26,898.

NEW YORK, N. Y.—The Commissioner of Public Works will receive bids until Oct. 4 for paving two streets each with asphalt on concrete and granite blocks.

NEWARK, N. J.—The Superintendent of Works will receive bids until Oct. 5 for paving one street, 3,200 sq. yds., with Trinidad Lake asphalt. Bids will soon be asked for paving Clay St. with oblong granite blocks.

WILKINSBURG, PA.—The citizens have voted to issue bonds for $55,000 for street improvements.

WILMERDING, PA.—Bonds will be issued to pave the principal streets.

CINCINNATI, O.—The Board of Administration will receive bids until Oct. 6 for paving one street with granite blocks, and until Oct. 13 for paving one street with brick. The City Auditor will receive bids until Oct. 13 for $55,000 of 4% bonds. Ordinances have been approved for paving one street each with brick and boulders.

CLEVELAND, O.—The Director of Public Works will receive bids until Oct. 5 for a brick culvert in Ackley Ave., near Mound St.

DAYTON, O.—The City Comptroller will receive bids until Oct. 7 for paving with stone flagging, cement or asphalt the sidewalks in seven streets.

FINDLAY, O.—Bids will be received until Oct. 21 for the improvement of Ely Ave. J. S. Humphrey, Cy. Engr.

NEWARK, O.—The City Clerk will receive bids until Oct. 24 for paving Granville St. with brick.

TOLEDO, O.—The City Clerk will receive bids until Oct. 17 for paving five streets with Medina stone, cedar blocks, vitrified brick, asphalt blocks, or Trinidad Lake asphalt. The lowest bid for paving Putnam St. with asphalt was that of W. R. Warren, $26,707 with Medina curb or $26,152 with Berea curb. The lowest bids for paving Bancroft St. were as follows: Thos. McKinney, brick, $15,240 with Medina curb, or $12,962 with Berea curb; John Stretcher, Medina stone, $18,352 or $18,805; W. R. Warren, asphalt, $19,732 or $19,395.

INDIANAPOLIS, IND.—The Board of Public Works will receive bids until Oct. 5 for seven contracts, including the paving of two streets with brick. The City Engineer is preparing the necessary papers for paving two streets with asphalt, and one each with granite blocks and brick.

EAST ST. LOUIS, ILL.—The contract for paving West Broadway with granite has been awarded to Veiths & Skrainka, St. Louis, Mo., at about $25,000.

DENVER, COLO.—The Board of Public Works will receive bids until Oct. 18 for sidewalks and other street work.

GREAT FALLS, MONT.—The City Engineer reports that it will cost about $30,000 to pave Central Ave. with brick. The specifications call for either brick or cedar blocks, and the work will be advertised 30 days.

SALEM, ORE.—A contract to improve about a mile of streets has been awarded to Archie Mason, at about $16,000.

ELECTRICAL.

BATH, ME.—A company is being formed to buy the lower falls of the Androscoggin River, just above Brunswick, and generate electricity to be carried to Bath, a distance of 14 miles. The water privilege there is said to be of 6,200 HP. Ex-Mayor Patten is interested.

BATAVIA, N. Y.—The Committee on Lights has been authorized to secure estimates as to the cost of a municipal lighting plant, after which a special election will be held and the question submitted to the taxpayers.

GLENS FALLS, N. Y.—The citizens of South Glens Falls have voted in favor of arc electric lights, and a contract for 18 or more lights has been awarded to the Glens Falls Electric Light Co. at 30 cts. per light per night.

ROANOKE, VA.—The Light Committee will receive bids until Oct. 16 for lighting the city by electricity.

BOARDMAN, WIS.—The New Richmond Electric Light & Power Co. was incorporated Sept. 22. A franchise has been granted to the company and a plant will be erected at once.

MUSKEGON, MICH.—The Board of Public Works will receive bids until Oct. 17 for not less than 150 lights of 2,000 c. p., contract for five years.

MISSOULA, MONT.—The Missoula Electric Light Co.'s plant and franchise has been sold to representatives of the Thomson-Houston Co. for $75,000, and it is stated that the new company will at once erect a large power plant on the river two miles above the city. The company is also negotiating for the introduction of an electric street railway line.

SEATTLE, WASH.—Bids have been received for an electric light plant for the city, and varied from $60,745 to $88,280.

ALAMEDA, CAL.—G. W. and A. G. Price desire to lease the electric light plant of the city for a term of years at $25 per month. They agree to furnish the city 91 arc lights, its present number, at $725 per month, moonlight schedule, and additional lights at $7 each per month.

NEW COMPANIES.—Dawson Electric Light, Heat & Power Co., Dawson, Pa.; $20,000; Treas., John W. Kurts. Jefferson Electric Light, Heat & Power Co., Punxsutawney, Pa.; $6,000. Bradbury-Stone Storage Battery Co., East St. Louis, Ill.; $500,000; S. M. Stevens, I. B. Crews, F. P. Hager. United Electric Co., Dennison, O.; $100,000; J. H. Wilson, G. I. Fleming, N. H. Smith.

CONTRACT PRICES.

SEWER WORK.—Roanoke, Va.—The only bid received for the proposed sewer was as follows: Skinker & Sims, earth excavation, 20 cts. per cu. yd.; loose rock, 40 cts.; solid rock, $1; concrete, $4; refilling, 20 cts.; laying 24-in. sewer pipe, 20 cts. per lin. ft.; 18 and 15-in., 15 cts.; 12 to 6-in., 10 cts.; manholes, $30 each; lampholes, $5; flush tanks, $40.

STREET WORK.—Binghamton, N. Y.—Nine bids were received for paving State St. with vitrified brick, the prices ranging from $2.32 to $2.68 per sq. yd.

Chester, Pa.—Contracts have been awarded to Richard & Lowry for grading, at 16 cts. per cu. yd., and to John Hanna for paving with vitrified brick, at $1.96 per sq. yd.

DREDGING.—Burlington, Vt.—Maj. M. B. Adams has awarded contracts as follows: Luther Whitney, Keeseville, N. Y., dredging 21,000 cu. yds., in Great Chazy River, 34 cts. per cu. yd.; Wm. J. Daly, Ogdensburg, N. Y., dredging 72,000 cu. yds. in Ogdensburg harbor, 44.9 cts., and removing 2,000 cu. yds. ledge from Otter Creek, $9 per cu. yd.; Lynch & Hannan, Odgensburg, N. Y., dredging 92,000 cu. yds. in Lake Champlain Narrows, 15 cts. per cu. yd.

DREDGING.—Newark, N. J.—The Superintendent of Works will receive bids until Oct. 5 for dredging Peddle St. canal.

PIER WORK AND DREDGING.—Ottawa, Ont.—Bids will be received until Oct. 11 for the extension of piers and dredging at Port Albert, Huron Co., Ont. E. F. E. Roy, Secy., Dept. Pub. Wks.

MISCELLANEOUS.

LEVEE BONDS.—Sacramento, Cal.—A special election has been ordered for Oct. 13, to vote on the issue of bonds for $100,000 for levee improvements.

DRAINAGE.—Seattle, Wash.—The Commissioners of Kings County have decided to cut a drainage ditch from the Black River to Kent. The total length, including branches, will be about eight miles, and about 3,000 acres will be drained.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Grant LocomotiveWorks, Chicago, Ill., have an order for 10 engines for the Chicago, Milwaukee & St. Paul. The Baldwin Locomotive Works, Philadelphia, Pa., have delivered 6 narrow gage engines to the Mexican National. The Great Northern will add 20 mogul engines to its equipment. The Richmond Locomotive Works, Richmond, Va., have orders for 2 engines for the South Bound, and several engines for the Chesapeake & Ohio. The Schenectady Locomotive Works, Schnectady, N. Y., are building 10 ten-wheel engines for the Chicago & Northwestern. The Pittsburg Locomotive Works, Pittsburg, Pa., have an order from the Chicago & South Side Elevated Railway for a simple engine of similar design and dimensions to the four-cylinder compound engines now in service, and which were described in our issue of Feb. 20.

CARS.—The Barney & Smith Car Co., Dayton, O., is building 10 passenger cars for the Southern Pacific. The Jackson & Sharp Mfg. Co., Wilmington, Del., is building 50 passenger cars for the Chicago, Burlington & Quincy, 45 for the Chicago & South Side elevated railway, and passenger and combination cars for the Buffalo, Rochester & Pittsburg. The Illinois Central has placed orders for 700 freight cars; they are to be fitted with Drexel & Janney couplers. The Wisconsin Central will add 30 passenger cars to its equipment. The Ensign Mfg. Co., Huntington, W. Va., is building 225 box cars, 200 flat cars, 75 freight cars, and 25 refrigerator cars for the Southern Pacific. The South Baltimore Car Works, South Baltimore, Md., have an order for 350 coal and lumber cars for the West Virginia & Pittsburg. The Chicago, Milwaukee & St. Paul will build 1,500 freight cars in its shops at Milwaukee, Wis.

THE MICHIGAN BRASS & IRON WORKS, of Detroit, Mich., have recently been awarded contracts for valves and hydrants, as follows: Norway, Mich., 57 hydrants and 60 valves; Geneva and Lacon, Ill., all the valves and hydrants necessary for the new water works; Wilmette, Ill., about 343 valves; Neenah, Wis., 65 hydrants.

COMPANIES.—Steel Brake Beam Co., Chicago, Ill.; $2,500,000; M. L. Willard, N. B. Judah, Solomon Wedeles. Martin Draw Bar Co., Chicago, Ill.; $1,000,000; Percival Steele, J. E. Roberts, L. L. Shirley. Chicago Fuel Gas Appliance Co., Chicago, Ill.; $250,000. E. R. Conant, E. K. Lightcap, Walter Farmer. Northwestern Brick Co., Milwaukee, Wis.; $50,000; S. H. Seamans, Rudolph Reinke, Lewis M. Ogden. Consolidated Steel & Wire Co., Chicago, Ill.; $4,000,000; Jas. H. Lacy, Edward McClelland, R. H. Donnelley. American Palace Car Co., Portland, Me.; $1,500,000. Locomotive Whistle Recorder Co., South Bend, Ind.; $10,000.

CURRENT PRICES.

RAILS.—New York: $30 at eastern mills, $30.75 at tidewater; old rails, $16.50 to $17 for iron and $14 to $14.50 for steel. Pittsburg: $30; old rails, $19.50 to $20 for iron and $15 to $16 for steel. Chicago: $31 to $32.50; light rails, $32; old rails, $17.50 to $17.75 for iron and $12.50 to $14 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.7 to 1.75 cts. for iron and steel; spikes, 2.1 to 2.15 cts.; track bolts, 2.6 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 60 and 10% and 50 and 10% on black and galvanized butt-welded; 70% and 60% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $13 to $15.50. Pittsburg: $13 to $14.25. Chicago: $13.25 to $14.75.

LEAD.—New York; 4.05 to 4.1 cts.; Chicago: 3.95 to 4 cts.; St. Louis: 3.87 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.35 to 2.75 cts. for small lots; channels, 2.25 to 2.5 cts.; angles, 1.95 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates 1.9 to 2.2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2 to 2.05 cts. for large lots, and 2.1 to 2.15 cts. for small lots; channels, 2 to 2.05 cts for large lots and 2.1 to 2.15 cts. for small lots; angles, 1.85 to 1.95 cts.; tees, 2.4 to 2.5 cts.; Z-bars, 2.1 to 2.15 cts.; universal mill plates, 1.8 to 1.85 cts. for steel; sheared steel bridge plates, 2 to 2.1 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.85 to 1.95 cts. for tank, 2 to 2.15 cts. for shell, 2.1 to 2.2 cts. for flange, 3.6 to 3.75 cts. for firebox. Chicago: beams, 2.15 cts. for large lots, and 2.3 to 2.5 cts. for small lots; channels, 2.15 for large lots, and 2.3 to 2.5 cts. for small lots; angles, 2 to 2.25 cts.; tees, 2.25 to 2.4 cts.; universal plates, 2.15 to 2.25 cts.; steel plates, 2.15 to 2.5 cts. for tank and shell; 2.5 to 2.75 cts. for flange.